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ACROSS PAPAGUERIA.

BY

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The Pacific coastal desert of North America extends from the region of the isthmus of Tehuantepec northward to include the peninsula of Baja California and a part of Upper California. To the eastward one broad arm spreads out from the shores of the Gulf of California to include nearly all of Sonora, the southern and western part of Arizona and the southern part of Nevada, in which regions it joins the higher bolsons, mesas and basins of Chihuahua, New Mexico, Utah, Nevada and California. The entire region is one of great aridity, and probably no part of it under 4,000 feet in elevation receives more than 12 inches of rainfall annually; the ridges and peaks which rise above this level may have three times as much, by the condensing action of their summits. On the other hand, the great area lying to leeward of the main peninsular ridge of Baja California and its northward continuation in California, are so situated that the annual precipitation is often as low as 2½ inches per year, while many localities receive no rainfall over periods as long as eighteen months, as noted by Palmer with regard to the Raza islands in the Gulf of California.

No adequate natural history survey has yet been made of any portion of this region. The Boundary Survey Commission traversed the northern part in demarking the southern line of Arizona, the most arbitrary and meaningless political boundary in America, and made collections in the immediate vicinity of the line, but the nature of the work did not permit any attempt at studying the general relations of the life of the region, although much detailed information was procured as to the composition of the fauna and flora.

In the preparation of a *résumé* of "The Botanical Features of North American Deserts" (Publication No. 99, Carnegie Institution of Washington) it became apparent that systematic information on the general features of this region was very meagre, and an expedition from the Desert Laboratory was planned which would traverse a route from Tucson to the Gulf.

Tucson occupies a position on the eastern part of the great flattish ridge which slopes from elevations of three to four thousand feet in southeastern Arizona, westward to the delta of the Colorado River and the upper part of the Gulf of California. A score of mountain ranges, including the Whetstones, Santa Ritas, Santa Catalinas,

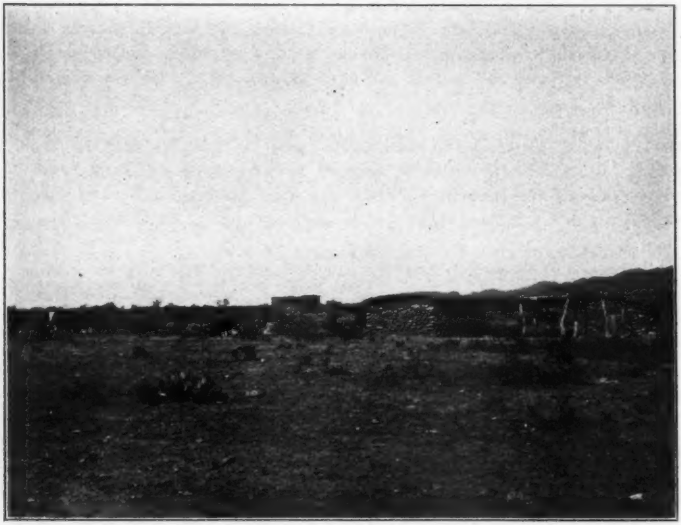


FIG. 1.—PORTION OF PAPAGO VILLAGE OF QUEROBABI.

Tortolas, Tortolitas, Sierritas, Tucsons, Carobabis, Baboquiviris, Quijotoas, Ajos, Growlers, Rincons, Dragoons, Mohawks, Gilas, Tules, Lechuguillas, Maricopas, Ciprianos, San Franciscos and San Rosarios, run transversely across the ridge with crests that rise to over 9,000 feet in some instances, the intervening valleys being for the most part broad, flattish troughs, with undeveloped drainage, opening to the northward into the Gila River and to the southward to the Altar and Sonoyta rivers in Sonora.

The greater portion of this ridge has been occupied by the Papago Indians, since they became differentiated from the Piman stock, per-

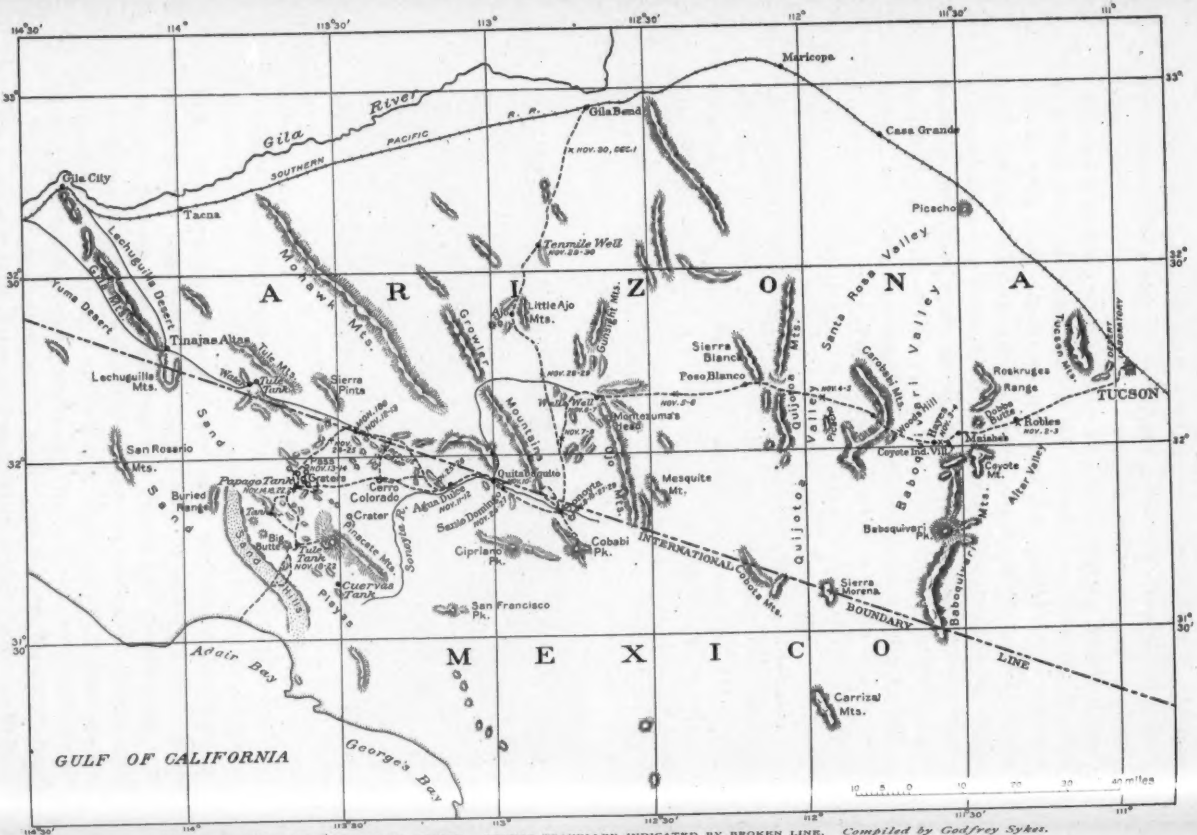
haps ten or twelve centuries ago, this tribe being first encountered by the Spanish of Coronado's expedition in the middle of the 16th century. The region became known as Papagueria and was traversed in many directions by zealous padres establishing missions and *visitaciones,* one of which, the famous San Xavier, survives to this day. The Indian still occupies the country as a whole, very much as he did at the advent of the Castilian, and his relations to the climate and the desert conditions, as revealed by various anthropological investigations, are as interesting, biologically, as anything to be encountered by the naturalist.

The expedition from the Desert Laboratory included Dr. W. T. Hornaday of the New York Zoological Park, Hon. J. M. Phillips of Pittsburg, Mr. Godfrey Sykes of the Desert Laboratory and the writer. Modern Tucson occupies the site of a frontier settlement of Papagueria, the mountains within sight across the plains to the northward and eastward being anciently held by hostile tribes. The crest of the high black hill, Tumamoc, on the west side of the Santa Cruz River, is occupied by the remains of a village, the double and triple walls surrounding it on the precipitous slopes giving it secure protection. These walls in part accentuate the serrated effect of some of the profiles and doubtless helped to suggest its Papago name, which means "the horned toad hill."

We were to follow the main trail from northeastern Papagueria to the salt beds on the shores of the Gulf of California near Adair Bay. A pilgrimage to these deposits became a matter of great economic and ceremonial importance in comparatively recent times, and salt brought from them is still occasionally offered for trade at outlying ranches. In addition to this historical interest, the general features of the fauna and flora promised evidence upon the major problems of habit and distribution of desert forms. Some of these reach their limit of occurrence on the slopes of the Santa Catalinas near Tucson and range southward and westward in Sonora between the mountains and the Gulf in such manner that the trip would make a complete section of their ranges.

The route followed the main height of land at elevations of 2,000 to 2,800 feet for a distance of 125 miles almost due west from Tucson until the northern end of the Ajo mountains was reached, when a sharp turn to the southward was made which soon took us out of the Gila drainage to that of the Sonoyta. This stream was first encountered south of the International Boundary near Monument 167 and about three miles east of the village of the same name.

The half dozen ranges encountered were traversed by low passes



MAP 1.—SKETCH MAP OF PINACATE REGION. ROUTES TRAVELLED INDICATED BY BROKEN LINE. *Compiled by Godfrey Sykes.*

of easy grade, and in the approaches a few wells have been digged and walled by the Government, but as they are not suitably guarded or cleaned it is quite as well for the comfort of the traveller that their depth prevents a view of the water and its contents, which often smell vilely when brought to the surface. In one, the badly disintegrated remains of rattlesnakes and other animals were found, and all of the water on this portion of the route except that within 25 miles of Tucson, was bad and perhaps dangerous, although no ill effects were experienced by any member of our party.

The Oasis of Sonoyta.

The general structure of the oasis of Sonoyta is fairly representative of such formations in American deserts, and its principal features merit description. A great ovoid plain, forty or fifty miles across, lies mostly south of the International Boundary, with its narrower and lower portion to the westward. The plain, once a basin-like valley, is now filled with detritus from the encircling mountains to a depth of a few hundred feet. The greater part of the precipitation here and on the slopes of the neighbouring mountains sinks down in this broken material, forming running streams on the surface only during seasons of heaviest precipitation. The water percolating through the detrital mass gradually makes its way toward the lowest part of the original valley, this being facilitated, perhaps, by layers of clayey material or hard-pan impervious to water, with the result that in following these gently inclined strata it is brought to the surface by various converging lines of drainage at the lowest part of the gravel-filled valley within a mile of the International Boundary. The stream formed flows along over the margin of the clayey layer, being exposed to enormous evaporation, and furnishing a surface supply which may be led out in conduits for irrigation purposes. Further down it encounters the sand or gravel beneath the clay and again sinks into the ground. In the brief seasons of flood the stream may run far down before it is swallowed by the porous sands, and as aridity increases the end of the water recedes far upstream. It is this short reach of living stream that forms the heart of the oasis, nourishing, as it does, a vegetation widely different from that of the surrounding desert and affording conditions for the cultivation of food-plants for the human animal. The oasis of Sonoyta has, doubtless, been the site of a cluster of habitations since the beginning of agriculture, and has been known to the Papagos for a thousand years by this name, meaning the place where corn (sonot) will grow. Very naturally, the upper

part of the oasis has the surest supply of water, and the steady population of about 150 people have shifted about in accordance with the changes in the stream and alterations in the irrigation systems. The lower, uncertain part of the stream, with its precarious conditions, has been the scene of hunter's camps and sporadic ventures with small flocks, the oft-recurring seasons of extreme drought discouraging any more serious operations.

Thus the records show that in the early nineties, the entire population was centered about the Hacienda Santo Domingo midway of the oasis, but at the time of our visit the village of Sonoyta, at the

FIG. 2.—SONOYTA RIVER, NEAR THE VILLAGE OF THE SAME NAME.

head of the living water, was the centre of activity, the Mexicans, perhaps 75 in all, being accommodated here in characteristic adobe dwellings, while smaller clusters of wattled houses of the Papagos were scattered along the valley and down the stream for five or six miles. The Mexican alcalde and the "Jacke" (pronounced "Hacke") or "gobernador" of the Papagos being the only recognized officials and administrators of civil law.

The old Hacienda of Santo Domingo, with its desiccated groves of fruit trees and grapes, ruined buildings and dismantled arrastra, presented a melancholy picture, although it was well understood

that the diversion of the waters of the oasis down to this point would practically restore it in a single season.

In the lower part of the oasis the streamway bends to the northward to within a short distance of the International Boundary, and near here, at Quitovaquita, a group of small springs ooze from the hillside a few feet north of the boundary line, and in flowing down to the lower ground their waters serve to irrigate a small field on the Mexican side. A single American had sought this refuge for the sake of the produce of the small field and of the small flock of goats which he tended.

The ancient road from Sonora coming through Altar and Caborca led through the oasis of Sonoyta and across the desert to Altar, California, crossing the Colorado River at Yuma. In the earlier days it was much traversed by Spanish priests and the guards for the missions, this route having been followed by Father Kino as early as 1699, and soon became known as a "Camino Real." Later, especially during the rush to California consequent upon the discovery of gold, it was attempted by many inexperienced in the rigours of desert travel, and the long arid stretches between Sonoyta and Yuma became the scene of scores of tragedies, as evinced by the numerous crosses of stones which are thickly strewn along the way, especially in the vicinity of the Tinajas Altas, a series of kettle holes high up on the granite, containing the only supply of water in a three-days' journey. Naturally enough, the way became known as the "Camino del Diablo."

Within a few minutes after our arrival in Sonoyta we learned that a party of six Japanese had come up through Altar and Caborca and had evaded the immigration guard at the oasis, going out over the old desert highway across the border to gain the freedom of the United States. Disaster was quickly encountered, and two of the party returned for water and help which was freely given by the natives. Again they made the trial, passing our camp by a detour in the night. A day later we encountered one on the desert, worn and exhausted, who intimated by signs that he and a companion had become separated from the remainder of the party and that his friend lay ill in a distant copse along the streamway of the Sonoyta. Supplies were furnished him and upon our return a few weeks later these two had made back to Sonoyta to recuperate from their struggle, while the fate of the remaining four remains unknown. The tangents are long from water hole to water hole and their end might remain undiscovered for a decade, although one would preferably hope that such endurance and determination might win a refuge.

Barley, wheat, corn, melons, figs, beans, and grapes are grown by the holders of water privileges in the oasis, but in quantities barely sufficient for the needs of the inhabitants. Some foodstuffs, including sugar and grain, are brought in from the outside. The small fields with their crops of introduced plants formed a striking contrast with the native vegetation fringing the streamway and the xerophytic forms of the adjoining desert. A heavy growth of mesquite (*Prosopis velutina*) occurs in places, the arrow-weed "cochinilla" (*Pluchea sericea*) inhabits plots of alluvium in the bottoms, while the batamote (*Baccharis glutinosa*) is taken by the Mexicans to denote places at which good water may be obtained by digging. The oasis is remarkable in the fact that it furnishes conditions which bring together three species of Parkinsonia (*P. aculeata, P. microphylla and P. torreyana*). An elder tree (*Sambucus glauca*) is represented by some large specimens. *Acacia greggii* is abundant, while the spiny smoke tree, or indigo tree (*Parosela spinosa*), occurs in the lower part of the oasis growing out in the gravelly flats in streamways, as it does in the Salton basin. A willow and a poplar are comprised in the larger growths of the oasis.

For a long period of years the oasis has practically been a free zone into which the products of Mexico and United States have been admitted, except for occasional application of customs regulations by visiting customs officials of Mexico. Official sanction for taking our large amount of equipment across the frontier into and out of the oasis into the country to the southward at this point was not easily brought about, however, and some intervention by President Roosevelt and Secretary Root was necessary to secure arrangements by which we were given the desired permission. This entailed the presence of a Mexican customs official, and Teniente Jesus Medina, with a detail of four privates from the Guardia Fiscal, marched from La Osa, a hundred miles to the eastward, to *visé* our papers and receive us into Mexico. This service was tactfully carried out, and, by engagement, Lieutenant Medina returned to Sonoyta two weeks later to render any aid necessary to the return of the expedition across the boundary, and give us full clearance.

During our stay of two days at Sonoyta some progress was made in the geographical work of the expedition. Southward from the oasis lies the Cobabi Range, the culminating peak of which has been, and is still given on the U. S. hydrographic charts as 9,457 feet. A visit to the summit was made by Mr. Godfrey Sykes, who made the height as 4,325 feet, and, as the aneroid carried was tested before and after the ascent, this elevation is probably very nearly correct.

From Sonoyta to Pinacate.

Recruiting the expedition to a strength of nine men and seventeen horses, a start was made down the Sonoyta Valley on November 10th, being stopped by the Sonoyta itself, which rose in flood as a result of rains in the Cobabi and Cipriano mountains, and subsided so quickly that it had only the volume of a streamlet on the following morning. We were now following the old Camino Real or "Camino del Diablo," a route which has been traversed by survey parties of the boundary commissions and other expeditions. The flood water had carried the stream a dozen miles below Agua Dulce, where a

Fig. 3.—Sink of the Sonoyta River below Aguadulce.

stop was made before starting to negotiate the long, waterless stretch westward to the Tule Desert. Upon our return the stream was found to sink three miles below at the Salada, which is over a mile in length and includes the low alluvial flats bordering the streamway.

Here, as in similar spots in this region, were found growing patches of salt grass (*Distichlis spicata*), salt bush (*Atriplex*), mesquite (*Prosopis*), and many plants of *Wislizenia* with bright yellow flowers.

Our Mexican scout explained that water reappeared at a place

lower down the courses of the river, at a place known as the "Batamotal" (the place where the batamote, *Baccharis,* grows), at which place it is much less highly charged than here, and is drinkable.

At this and other camps in the arid southwest, many opportunities have been found to make observations on the ends of the currents of desert streams in sinks and playas. The lessened evaporation gives the attenuated current greater volume during the night, and an increase is visible within an hour before sunset, while by morning small streams coming out of mountain cañons will be seen to make out a distance of a hundred yards farther than in the daytime, before sinking in the sand.

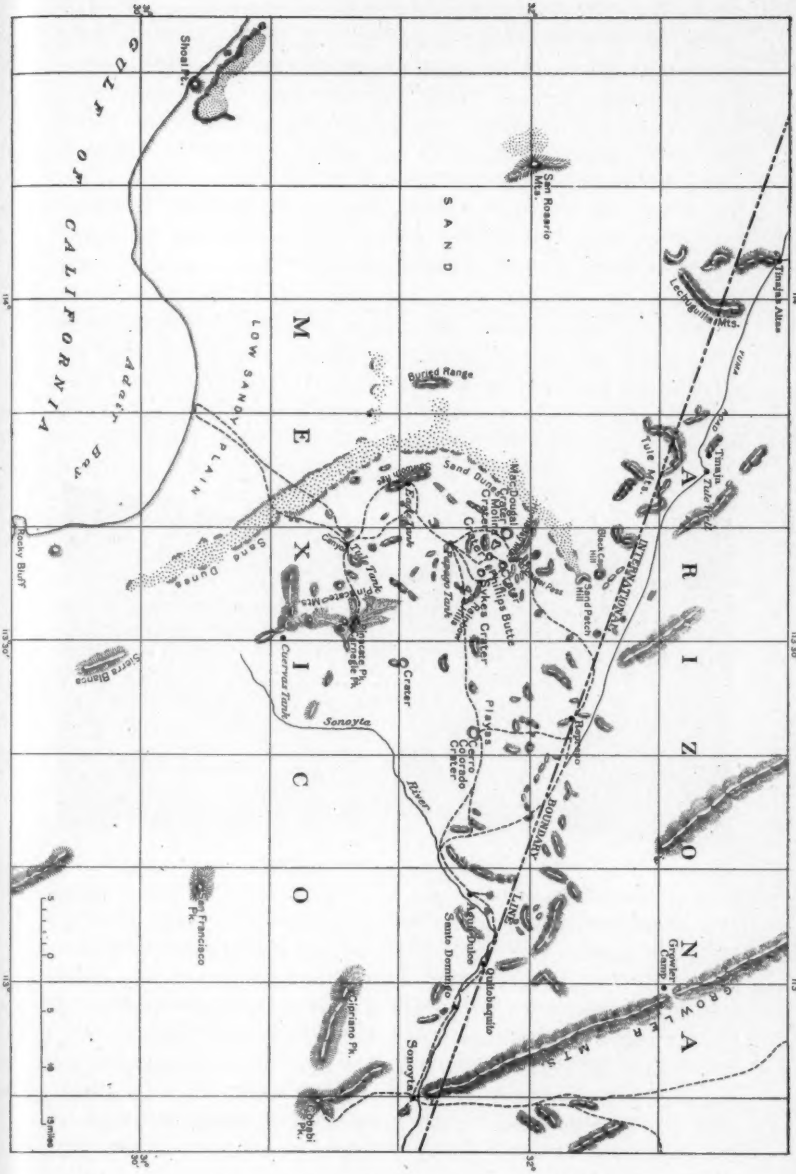
While the wagons were being taken along the Camino del Diablo to the Tule Desert, a number of the party made a detour to the southward to examine a huge cinder cone, with a large and perfect central crater, known as the Cerro Colorado, that lies 12 miles east from Pinacate. Around its northern base is a great undrained area or playa, which accumulates considerable water in times of precipitation and bears a heavy crop of Indian wheat (*Plantago aristata*), upon which antelope were feeding. The base of the Cerro Colorado is fringed with a wide sloping zone of ash and fine cinder, suggestive of comparatively recent activity.

A temporary supply of water, which had vanished a fortnight later, was found in depressions in other playas near Monument 180 on our advance trip, and from a camp here the route was laid to the southward to gain the western slopes of the Pinacate Mountains proper.

Progress now became somewhat more difficult. Slopes of rough lava and great stretches of *malpais* were interspersed with ridges and ranges of granite of varying height. Among these a route was found to within a mile of one of the largest outlying sunken craters of the group. Numerous flattish dunes and drifts of sand were also encountered. South of Monument 180, a distance of about 20 miles, a level pass was found leading directly in to the volcanoes. To the right or westward of the pass were the irregular slopes and jagged summits of a small granite range, which rose abruptly from the plain on all sides and which we named the Hornaday Range, in recognition of the work of Dr. W. T. Hornaday, who travelled completely around them in company with the author and made an examination of the fauna.

The Pinacate volcanoes might be enclosed in an oval figure, 60 miles in length and half that width, with its long axis running from southeast to northwest, lying directly inland from Adair Bay, from

MAP 8.—SKETCH MAP OF SOUTHERN ARIZONA AND SOUTHWESTERN SONORA. THE ROUTE IS INDICATED BY A BROKEN LINE. *Compiled by Mr. G. Sykes.*



MAP 2.—SKETCH MAP OF SOUTHERN ARIZONA AND NORTHWESTERN SONORA. THE ROUTE IS INDICATED BY A BROKEN LINE. *Compiled by Mr. G. Sykes.*

which the culminating peak is about 32 miles distant. The ascent of the main peak was made on November 20 by five members of the party and a record left in a cairn on the summit. A count made of the cones and craters within a limited section of the region which could be seen clearly on the hazy day on which the ascent was made justifies the estimate that at least 500 cones and craters in various states of preservation were included in the Pinacate volcanoes. Pinacate reaches an elevation of 4,060 feet, and the summit represents the eastern half of one of the largest craters, while around it in all directions lie other cinder cones, the slopes of which have the maxi-

FIG. 4.—PAPAGO TANKS IN PINACATE MOUNTAINS.

mum steepness permitted by the character of the cinder of which they are composed. Work on these slopes was accomplished with no little difficulty. In addition to the laboured climbing in the sliding ash, this material afforded suitable conditions for *Opuntia bigelovii*, and the climber might by a slight slip find himself precipitated into a clump of it, with consequent discomfort or even serious danger.

The secondary peak of the range, also a fragment of a huge crater, lying to the southeast of the main cone and but slightly less in elevation, was designated as Carnegie Peak by the members of the expedition. (See map 2.)

On November 14th, the expedition traversed an extensive plain made up of the gentle detrital slopes from encompassing granite ridges, worn down nearly to base level and bearing great stretches of galleta grass and creosote bush, over which roamed numbers of wild horses. The close of this day's journey found us camped in MacDougal Pass, which separates the Hornaday Mountains from the main volcanic formations of the Pinacate volcanoes to the southeastward. On the following day the resumption of the march brought us within three miles of a field of lava impassable with vehicles, but within easy reach of some of the more interesting topographical features of the region. Here the wagons were unpacked, the equipment assorted, and a selection necessary for further work was carried in on pack saddles to the Papago tanks. These tanks are a series of kettle holes in the granite, laid bare by erosion of a streamway carrying the drainage of enclosed valleys in the northern part of the Pinacate volcanoes. The tanks contained a few thousand gallons of water in the aggregate and are probably never totally emptied, though the level of the water was perceptibly lowered by the draft made on them during the fortnight of our occupation. These tanks are the most reliable source of water in the northern section of the volcanoes, and after they are passed the explorer must proceed to the southern end of the range to the Cuervas tanks, or to the Chives tanks, although we found a plentiful supply in the Tule tanks, 18 miles to the southward.

Abundant indications of former occupation by Indians, probably of Piman stock, are found. Near all of the water holes are numerous mealing holes, which by their depth testify to long usage, while converging trails are plainly marked in the lava and granite, those coming into the Papago tanks being worn to a depth of over a foot in places. A second convergence is to be noted of ancient highways which lead to the salt deposits on the shore of the Gulf, near the northern end of Adair Bay. The region of the volcanoes around the water holes and including the salt beds appears to have been most recently occupied by a section of the Papagos known as the Areneros, who seem to have been much more devoted to hunting than their agricultural relatives to the eastward and northward, and whose aggressive qualities led them into much trouble with their Mexican neighbours and Indian relatives. The entire region has been evacuated by them, however, and, except for an occasional pilgrimage to the salt beds, the water holes are entirely unoccupied.

Craters of Pinacate Volcanoes.

The northwestern part of the Pinacate region which we had entered is characterized by great sunken craters, the rims of which lie but little above the level of the surrounding lava slopes of older formation. Three of these were examined with some care. One of the largest lies almost due south from the pass at the east end of Hornaday Mountains, and has a diameter of about 1,200 yards at the bottom, with almost vertical walls going down 400 feet. So far as our examination could be depended upon to yield an accurate interpretation, this crater had thrown out cinder and mud at various times, as evinced by the deposits on the plain around its rim. The walls showed granite strata and various lava deposits from older volcanoes. The rim had been eroded down at a few places and the detritus carried by small streamways toward the centrum of the floor. The larger and more striking plants had arisen along these small streamways, thus having the appearance of radiating from the central portion toward the rim. Among these were the sahuaro,

Profile 1.—MacDougal crater, 400 feet in depth.

ocotillo, galleta grass, dodder, *Parkinsonia,* ajo, *Hibiscus, Tribulus, Pectis,* golondrina (*Euphorbia*), *Dalea* and *Amarantus.* The soil in the extreme lowest part of the crater was distinctly moister, and here the herbaceous forms mentioned grew very densely, making a distinct patch that forms a marked feature when viewed from the rim.

The Molina crater, which lies two miles to the eastward, likewise has its rim but little above the surrounding lava beds, its name being suggested by its form, being, in fact, composed of three craters, the intervening walls having been carried away to give the aggregate a trifoliate form.

Sykes crater, 3 miles north of Papago tanks, has built up a rim on the stratified material through which it penetrates, so that it has a depth of 750 feet. The walls are so little broken that in only one place has a slide been formed, down which a descent may be made. Mr. G. Sykes made the descent and obtained the measurements and material described and his name has been applied to the crater. *Encelia, Sphaeralcea, Nicotiana,* mesquite, *Baccharis,* palo verde,

Covillea, sahuaro, galleta grass and Bigelow's opuntia were found on the rough floor of the crater, the bowl of which has a diameter less than twice its depth, and hence presents the most imposing appearance of any that were visited. Here, also, the product of eruptions included both cinders and mud of comparatively recent date.

To the westward of Sykes crater lies Phillip's Butte, which rises directly from the crater with which its slopes are continuous and reaches an elevation of about 1,500 feet.

In order to make the ascent of Pinacate and visit the shore of the Gulf, five members of the party left the main camp at Papago tanks and proceeded with a pack outfit to Tule tanks, 18 miles to the southward. Bands of antelope were encountered on the intervening slopes, while the entire region contains numbers of bands of mountain sheep

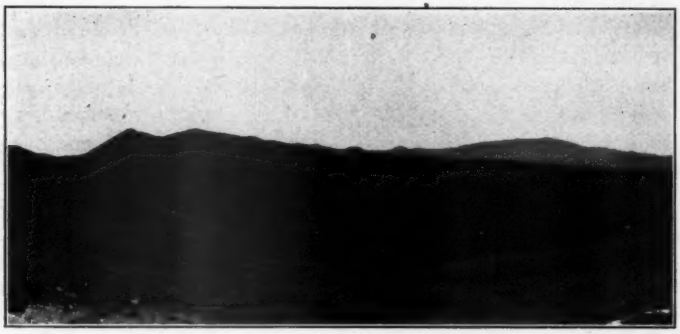
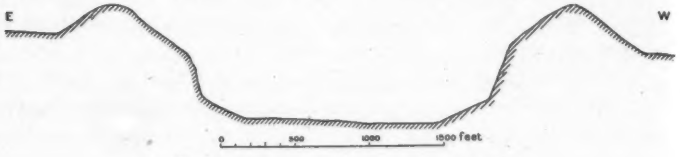


FIG. 5.—SYKES CRATER IN PINACATE MOUNTAINS.

(*Ovis canadensis*). The sahuaro, *Covillea* and an *Ephedra,* as well as a prickly pear, are found near the summit of Pinacate and collections were also made, including *Eriogonum, Perityle, Monardella, Verbena, Sympetala rupestris, Groton, Euphorbia,* and a few others, the identity of which is not yet known. Mr. G. Sykes marched from the camp at Tule tanks to the shore of the Gulf and returned, a total distance of 42 miles, in one day, extending the line of our inspection to sea-level, and allowing opportunity for the correction of aneroids. The shore near Adair Bay is fringed with wide flats nearly bare, which are partially submerged at the highest tides. Above this is a belt 3 to 5 miles in width, in places covered with a dense growth of galleta grass, beyond which lie the great ranges of sand dunes, piled up to a height of 80 to 100 feet in places, making a zone several miles wide. The streamways from the slopes come directly

against the upper side of these dunes and repeated floods have carried down material which has been spread out to make broad playas at these places. Such a termination is reported of the Sonoyta River, although not actually observed by any member of our party. This river during the season of greatest floods makes to the eastward and



PROFILE 2.—SYKES CRATER, 750 FEET IN DEPTH.

in a southerly direction past the Pinacate volcanoes, and then veers slightly to the westward, coming against the dunes south of the main peak, and sharing the fate of the lesser streams. Previous visitors to contiguous regions have described the Sonoyta as going around the north end of the range, a statement now corrected for the first time.

FEATURES OF THE VEGETATION.

The region traversed by the expedition might be properly termed the northernmost portion of the desert which extends southward along the Pacific coast to the Isthmus of Tehuantepec. The precipitation is less than a dozen inches, except on the higher summits, the greater part of the yearly rainfall coming in midwinter and midsummer. Temperatures of 118° and 120° F. have been recorded in the lower levels, some places showing a daily maximum during portions of six months of every year. The possible evaporation that would ensue from a water surface on the plains would probably be between 70 and 80 inches per year, or about six to eight times the precipitation. The general aspect of the vegetation is highly xerophytic, although of some abundance. An analysis of the flora, however, shows that a large proportion of it, as in all western American deserts, is made up of annuals and perennials which are active only during the periods of maximum precipitation in summer and winter. These forms do not exhibit any structures which distinguish them from mesophytic species of moister regions, but they have peculiar rhythms and dormancies. The seeds of many of the winter annuals will germinate only in the low temperatures of the winter months, lying wholly inactive during the summer rains, while the summer annuals are equally unaffected by the moisture and stimulus of change

of the cooler months. As a result of the arrangements in question, the vegetation shows an intricate interlocking of temperate and subtropical forms with, of course, a very large number of endemic species of both classes. Legumes are abundant and are represented by a great number of forms. Most remarkable of all, however, are the cacti, a group of comparatively modern origin, and including hundreds of species, some of which are extremely restricted in distribution.

Of these, the sahuaro, or giant cactus (*Cereus giganteus*) is probably the most prominent by usefulness and obtrusiveness of all the striking forms that inhabit the desert land of the Papagos. It ranges from the Tonto basin in central Arizona westward to the Colorado River, which it crosses to occupy a small area in California in the vicinity of the mouth of the Bill Williams River. It extends to the eastward to the drainage of the San Pedro River and southward in Sonora to the latitude of Guaymas, its exact southern limit not being determined, and follows close to the Gulf up to its head. In the northern portion of its range it occupies sunny slopes at an elevation of 4,000 feet and it descends into some of the old craters of the Pinacate volcanoes to a point but little above the sea-level, climbing the main peak near by to the maximum elevation. As the limits of the range of the sahuaro are approached, branching becomes less profuse and the outlying individuals show simply columnar trunks, usually showing some marks of the stress under which they exist. In more favourable localities an unending variety of grotesquely arranged branches is to be seen and secondary branches are exhibited in some instances. Native guides are given to informing travellers, with apparent sincerity, that the branches are in reality separate plants which have risen from seeds deposited in cracks of the trunk by woodpeckers and other birds. It has been pointed out recently (Turrell, C. A., *Univ. of Ariz. Monthly*, Jan., 1908) that the name for the great tree cactus (*Cereus giganteus*) must have been a Castilian rendering of an ancient name in use when the Spanish explorers first came, and as the use of the *g* with the sound of *w* was unknown, the proper spelling of the name of this plant would be "sahuaro" instead of "saguaro."

It would be difficult to estimate exactly the importance of this plant to the animal life of the area which it inhabits. Its flowers, opening in May and June, offer food and shelter to countless swarms of small bees and gnats. The ripening fruits furnish a profusion of seeds and a wealth of sweetish pulp to birds and smaller mammals, while the Indian makes use of both portions of the fruit, fresh, fer-

mented and preserved. Scores of tribal battles have been fought in Papagueria over the sahuaro harvest. The seeds which reach the ground quickly germinate in the baking soil, and the tiny capsules of acid water stored in the plump spineless hypocotyl constitute a most attractive morsel for thirsty and hungry animals, and not one seedling in a million survives the first year, in consequence. The bases of large plants are stripped and gnawed by rabbits and hares in the southern portion of the habitat, while carpentarios, or woodpeckers, bore huge cavities into the soft outer tissue which are quickly lined with a callus formation, forming a fine nesting cavity. These cavities also offer storage room and shelter for swarms of honey bees. With so many animals making use of the fleshy trunk and branches, the greater number of the sahuaros perish before reaching a height of forty feet. The central pith and the thick outer cylinder of pulp quickly decay, leaving a fascicle of woody rods anastomosing in the older lower portions, but free in the upper terminal parts.

The woody skeletons of the sahuaro form a light and strong building material much used by the Papagos in making the picketed walls of their jacales, or barriers around small gardens or corrals. Illustrations of such uses are to be seen in the city of Tucson. Recently, Mr. Fred. C. Wright has discovered a process of dehydration and tanning that will greatly increase the usefulness of the sahuaro. (*Plant World,* May, 1908.)

The opuntias, with flattened stems as well as the cylindrical forms, force themselves persistently on the attention of the traveller in Papagueria, and great discomfort or even serious injury may result from an unguarded encounter with these armed plants. The heavy rigid spines may penetrate deeply into the flesh, and the glochids, which form short tufts at numerous places on the surface and are easily detached, quickly work into the skin with highly unpleasant results. It is to these structures that attention is chiefly directed in the effort to get an opuntia useful for forage and salad. A dozen species spineless, or nearly so, are known; but the breeder must get a form which does not develop the glochids beyond a rudimentary stage, if the most offensive features of the armament are to be avoided.

Some of the cylindrical forms are arborescent, with widely spreading branches. The joints are easily detachable, so that a slight contact causes the spines to pierce the clothing or skin and a joint of the stem comes away bristling with a score of spines and some of these also pierce the flesh. The instructed use a stick or a pair of tweezers to remove the pest. Dogs, horses and cattle reared in cactus regions,

learn to free themselves by a shaking motion. Attempts to remove the detached joints by the fingers are often disastrous.

The ease with which the joints are detached, the facility with which they become attached to animals and the rapidity with which these segments root and form new plants when dropped, make this one of the most important methods of reproduction. This is true especially of *Opuntia mamillata* and *O. fulgida.*

These two forms were formerly thought to be included in a single species, but on all of the expeditions from the Desert Laboratory they have been found easily distinguishable. They offer a marked example of closely allied forms living in the most intimate proximity.

The acid fruits are not set free until they are three years old or even more, in some instances. After the pulp decays, the hard seeds lie on the ground inactive for months or even years, meantime being subject to the action of numerous rodents which gnaw through the hard outer coat to get at the embryo. Both species are known as "cholla," a name loosely used, and sometimes applied to any cylindrical opuntia, although it strictly belongs to a species native to Baja California (*Opuntia cholla*).

A number of rodents fortify their burrows with joints of the cholla which are dragged into such position around the entrances as to allow a crooked passage for the occupants, but which would discourage the marauding coyote, cat or fox.

The spines and glochids of the cacti do undoubtedly lessen the ravages of grazing animals to some extent, but no ground is afforded for the conclusion that the armature is a direct and purposeful response to the injuries inflicted by animals. The structures in question seem to have been induced by aridity and in a dozen species the evolutionary development has been carried still farther and the spines are reduced to the merest rudiments. Singularly enough, the two poorly armed species, occurring in the vicinity of Tucson, are not seriously molested by animals. It is also to be noted that while the cacti seem to be especially suited for arid conditions, yet many species occur in moist tropical forests.

Two massive forms of melon cacti or biznagas (*Echinocactus wislizeni* and *E. emoryi*) were encountered by our expedition at elevations above a thousand feet in Sonora and Arizona, while a third, with a number of smaller heads in a cluster, was seen nearer the Gulf of California. The larger species often measure over 5 feet in height, with a diameter of more than 2 feet at the base, containing as much as 6 or 8 gallons of water. This sap is only slightly charged with substances ordinarily in solution in the plant-cell, and an Indian

runner, striving to make a swift journey in Papagueria, need not carry water with him, but may resourcefully shape his way to meet these "biznagas," from which a grateful supply of satisfying liquid can be quickly obtained. Some travellers speak slightingly of the juice as a drink, and magnify the difficulty of its extraction. It has, however, proved useful on many expeditions, and if the thirsty traveller is so fortunate as to be armed with an ax or a large knife, he may secure a quart of liquid within seven to ten minutes. Lacking these, he must burn away the huge spines and then crush the top and pulp with a stone before the juice can be squeezed with fingers into a centrally made cavity, a method which may need twice as much time, but which might avoid serious consequences from thirst in a region in which a man at work uses as much as sixteen pints of water daily.

Not all melon cacti can be expected to yield their store of water so readily, however. *Echinocactus grandis* attains the height of seven or eight feet and a thickness of a yard in the desert of Tehuacan in southern Mexico. The firm pulp is heavily loaded with lime, so that when chewed it is unpleasantly gritty; the juice is not obtainable by the methods used with the Sonoran species. It is reported, however, that water is obtained from some species in South America by the native Indians.

A general view of the entire region shows that it includes as the principal topographical features a series of minor ranges of mountains trending in a northerly and southerly direction, which have undergone tremendous erosion in a desert climate, with the result that the intervening areas are great valleys or bolsons filled with detrital material brought down from the mountains. The soil is very poor in humus, the drainage is undeveloped, oases of peculiar structure occur, the diurnal changes of temperature are of wide amplitude, the effects of wind erosion are very marked, the precipitation sustains a very low ratio to the possible evaporation, as a consequence of which all areas under 4,000 to 6,000 feet are strongly desert in character. Within the limited areas offered by the higher mountain slopes, much more mesophytic conditions prevail by reason of the greater precipitation and decreased evaporation. In such comparatively humid localities a vegetation of mesophytic forms is encountered, forming islands in this great desert. Also at lower levels there occur a large number of species which carry out their entire cycle of activity during the brief rainy seasons or periods of greatest precipitation, and these do not exhibit any marked xerophilous qualities, except that the dormant seeds or quiescent roots are capable of withstanding great periods of drought without damage.

The greater proportion of the area, however, is occupied by true desert species, which by structure and physiological capacity are well equipped for the arid conditions prevalent. In some, structures which prevent loss of water are most noticeable, while in others, the capacity for the absorption and retention of surplus water during times of precipitation is developed to an enormous degree.

So far as the geological record is to be taken as fairly interpreted, arid conditions have prevailed here since Pleistocene times. No unmistakably xerophilous plant remains have yet been unearthed by the palæontologist, and we are driven to the conclusion that the cacti and other characteristic plants of this region must have originated within the present arid period.

The overshadowing influence of desiccation on development makes it impossible to select any given place as a meeting or mingling point of the forms occurring at the higher level and those native to the coastal region and extending far to the southward.

A number of species are found over its entire breadth from elevations of 3,000 and 4,000 feet in southeastern Arizona to the dunes near the shore of the Gulf, a distance of 200 miles. Among these are to be included *Cereus giganteus, Covillea tridentata, Encelia farinosa, Prosopis velutina, Fouquieria splendens and Parkinsonia microphylla,* all of which are essentialy desert species, showing marked xerophytic structures. Some of these species extend hundreds of miles north and south of the region under discussion, with a total range in excess of the variation of conditions which would be furnished by a vertical mile of mountain slopes. Then a large number of other forms occur in very narrowly restricted areas or pockets, evidently determined by local drainage or moisture conditions, so that an analysis of their inter-relations which would make possible a delimitation of "life zones" is extremely difficult. Thus, in traversing the slopes from 4,000 feet in the vicinity of Tucson to sea-level, the only place where any distinct alteration in the character of the flora may be discerned is at the junction of the lava beds with the gravelly detrital plains, and at the contact of the sand dunes with the playas on one hand, and at the contact of the sand dunes with the Gulf.

A GEOGRAPHIC INTERPRETATION OF NEW YORK CITY, PART II.*

BY

F. V. EMERSON.

THE LARGER HINTERLAND.—With the opening of the Erie Canal New York City entered upon its modern phase of development. An extensive and fertile hinterland had been made available which for thirty years was to be tributary to that city for its export trade. Under the influence of the canal northwestern New York rapidly became settled. The fertile soils were given to the production of wheat for which there was a rapidly enlarging market in the Eastern States. A foreign market was also opened by the repeal of restrictive English laws.† Where the Genesee River plunges into a post-glacial gorge, the milling city of Rochester grew up as a response to the wheat belt of the State and to the water power that was available for milling.‡

But the most important thing for New York City was the hinterland west of New York for which the canal was practically the only export route and New York the only port. The hinterland opened by the Erie canal extended from the Ontario plains to Wisconsin, but it was the country south of Lake Erie and Lake Michigan that was, in particular, tributary to New York during the years 1830-50, when the Erie Canal was the principal route to and from this region. It included most of Ohio, the northern halves of Indiana and Illinois, southern Michigan, and southeastern Wisconsin.

This is a region of moderate relief, a relief in part resulting from the glaciation of the region, which filled the pre-glacial valleys with drift scores and even hundreds of feet deep. The drift, in contrast with that of New England, is not notably stony. It is largely derived from shales and limestones, and is, in consequence, largely of fine material suitable for conversion into fertile soil.

The surface, although not level, is smooth in contrast to the Allegheny Plateau to the east. A study of the recorded elevations in Ohio shows that over seventy per cent. of them lie between altitudes of 600 and 1,000 feet; in Indiana about fifty per cent. lie between the same altitudes; in Illinois, nearly ninety per cent. of these

* Part I printed in BULLETIN for October.

† W. P. Sterns' "Foreign Commerce of the United States." *Journal Political Economy*, 8: 490.

‡ From 1829 to December, 1831, Rochester exported 529,725 barrels of flour. Niles' Register, 39: 334.

altitudes lie between 400 and 700 feet.* These elevations, however, are largely from readings taken in valleys. The general altitude, as shown by the large scale topographic maps, is from 500 to 1,000 feet.

The drainage of this hinterland is for the most part established on the recent Wisconsin and Illinoian drift and is in the youthful stage of erosion. The divides are broad and comparatively level, the valleys generally narrow, and swamps are not infrequent.

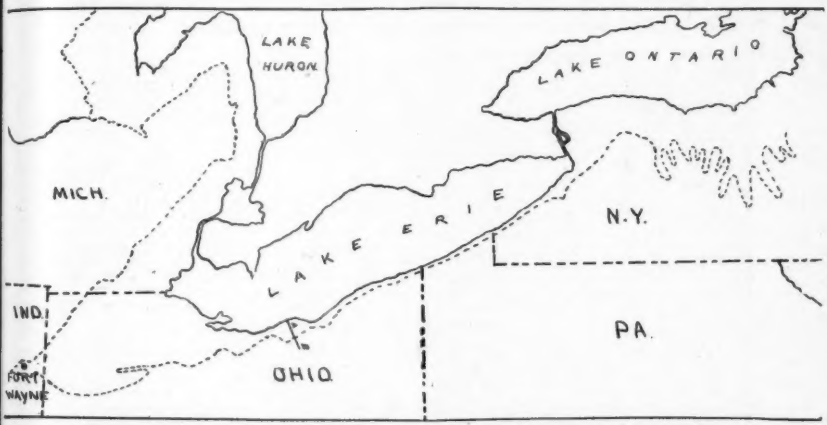


FIG. 18.—Map showing the maximum extension of the glacial lakes in the Indiana-Ohio New York region. The line *A B* in Ohio shows the location of the section in Fig. 19.—Leverett and Taylor, Monograph 41, U. S. Geol. Survey, plate 26.

The Wisconsin ice in its retreat from the Ohio-St. Lawrence divide, ponded the waters flowing north from that divide. The result was a series of marginal lakes, a late member of which was Lake Warren, which has been mentioned before. The maximum extension of some of these lakes is shown in Figure 18. The principal results of geographic interest of these lakes are: their abandoned outlets, their beaches, and the fertile lacustrine silts and clays that accumulated on their bottoms.

The soils of the region are fertile, and their fertility results from several causes. The soils are mostly of glacial origin and largely derived from local shale and limestone which are easily comminuted and furnish available plant food. The cool climate, the low slopes and the poorly organized drainage make for the accumulation of humus, and this, together with the fine material of glacial origin,

*The data for the computation are taken from "A Dictionary of Altitudes," Henry Gannett, U. S. Geological Survey. 1899.

produces the rich, black prairie soils. Within the limits of the marginal glacial lakes are found the very fertile soils composed in part of lake silts.*

The lake beaches and their accompanying deltas and bars were available for easy settlement, and the beaches and bars offered good roads.† The use of these beaches for roads and railroads is well shown in the topographic maps of the Cleveland region. The immediate offshore deposits, often mingled with clay silts, give a fertile, warm loam‡ (Fig. 19). Farther west in Indiana, Illinois, Iowa, Nebraska and Missouri, the loess soil is more abundant. It gives rise to an exceedingly fertile soil.§

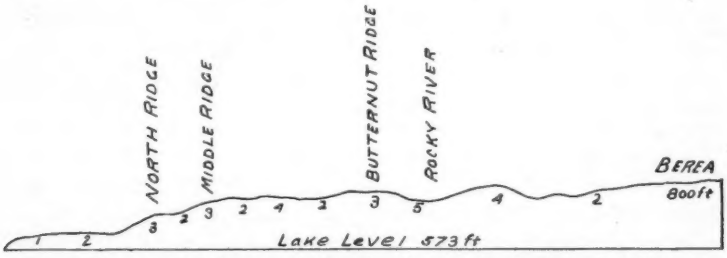


FIG. 19.—Diagram to show the relations between shore lines and soils. Profile from Lake Erie near North Dover, Ohio, southeast to Berea, Ohio. There are three well-marked beaches: North Ridge, Middle Ridge, and Butternut Ridge. Soil types: (1) DeKalb clay, formed largely by wave action on shale cliffs. (2) Miami clay loam, consisting largely of drift mingled with weathered fragments derived from the underlying shale. (3) Dunkirk gravelly loam, a soil characteristic of the ridges that were beaches of former glacial lakes. (4) A clay soil, consisting largely of offshore deposits. (5) Wabash loam, alluvial soil deposited on a flood plain. From the U. S. Soil Survey Report of the Cleveland, Ohio, Area, 1905.

The climate of the Upper Mississippi Basin is continental. The hot summers and cold winters give the large temperature range characteristic of the continental climate. The rainfall is ample and fairly evenly distributed through the year. It is a climate well adapted to cereal crops and dairy farming.

The Responses to the Larger Hinterland.

POPULATION AND PRODUCTS.—The responses to the level, fertile lands with their easy access by canal and lake were rapid. In 1820 the settlements in this region were grouped along the Ohio River (see Fig. 11), but by 1830 northern Ohio and Indiana had filled up so that they possessed a density of six to forty-five inhabitants per

* For example, see the following soil reports: Miami Black Clay Loam, Toledo, O. Area, 1902; Dunkirk Clay, Ashtabula, O. Area, 1903; Clyde Series, Saginaw, Mich. Area, 1904.

† Geological Survey of Ohio, 1870, p. 322.

‡ For example, the Miami soil series; Toledo Area, 1902; also, the Dunkirk series, Ashtabula Area, 1903.

§ Soil Survey of Winnebago Co., Ill., 1903.

square mile. As early as 1823 the number of passengers and immigrants landing at New York exceeded not only that of any other port, but was more than the combined numbers entering Boston, Philadelphia, and Baltimore (Fig. 20). Until 1855 there was no division of the passengers so as to show the number of immigrants. Of the immigrants, a large number passed through the Erie Canal to its tributary territory. In 1855 it was estimated that thirty per cent. of the immigrants landing at New York passed through the Erie Canal into Ohio, Michigan, Illinois, Indiana, Iowa, Wisconsin,

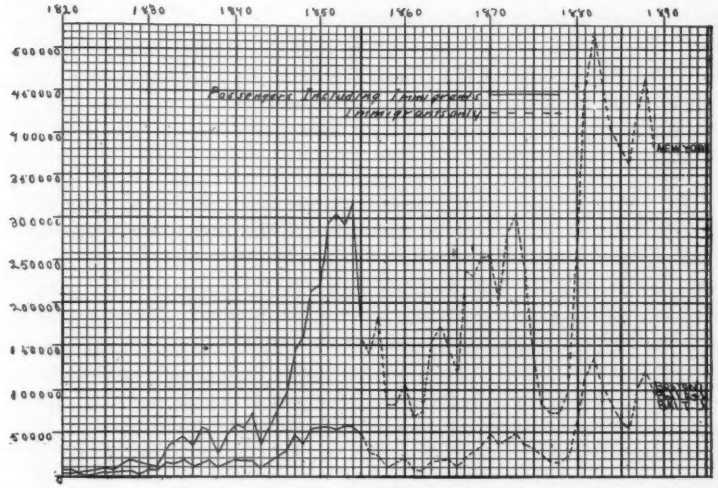


FIG. 20.—Total number of passengers arriving each year, 1820 to 1855, and total number of immigrants arriving 1856 to 1889.
From "Tables of Alien Passengers and Immigrants from 1820 to 1888. Treasury Dep't, Bureau of Statistics, 1889."

and Minnesota.* Prior to that time the percentage must have been greater, since there were not lines of easy communication from New York westward other than the Erie Canal until 1835. According to Andrews, the principal work of the boats in Lake Erie at that time was the transportation of immigrants and their effects westward from Buffalo.†

The prairie plains of northern Ohio, Indiana, and Illinois were easily brought under cultivation and produced bountiful crops, but

*E. J. Benton. *The Wabash Trade Route in the Development of the Old North West.* Johns Hopkins University Studies, 21: 1, p. 97.

†Israel D. Andrews. *Trade and Commerce of the British North American Colonies and the Trade of the Great Lakes and Rivers.* Thirty-second Congress, First Session; Executive Document, No. 112. 1853 p. 55.

the lack of an accessible market made the surplus crop almost superfluous, for the bulky crop would have its value consumed in transportation to market. Andrews, writing in 1854, estimated that, according to the current prices, wheat would have its value consumed by the cost of wagon transportation in a journey of 330 miles, and corn in a journey of 170 miles.* Before the end of the decade 1820-30 it is estimated that the Erie Canal had reduced freights to the East 66 per cent.† The great wheat-producing region was transferred from western New York to Ohio and later to the westward. In 1830 Rochester imported 200,000 bushels of wheat from Ohio and her wholesale trade reached to Detroit.‡

In 1834 Chicago felt the quickening influence of the canal, and in two years had multiplied her commerce many fold.§ The spread of population in Michigan was somewhat slower, but in 1840 immigration into that State had become very active, especially in the southern part.‖

THE OHIO CANALS.—The success of the Erie Canal was a stimulus to which the physiographic conditions of the region north of the Ohio allowed a ready response. The north-south direction of the river valleys of Ohio and Indiana suggested available canal routes up to the Ohio-Lake Erie divide, which is of moderate elevation and has been but little dissected. Moreover, the northern and central portions of those States are deeply covered with drift which was easily excavated. Five routes were considered, all of which included the partial canalizing of some of the north-south rivers (Fig. 21). They were: The Mahoning-Grand River route; the Cuyahoga-Muskingum route; the Black-Muskingum route; the Scioto-Sandusky route; and the Maumee-Great Miami route.¶ Of these, two compromise routes were authorized in 1825. The Ohio and Erie Canal was to pass from Cleveland up the Cuyahoga Valley over the divide and down the Scioto Valley to Portsmouth. It was completed in 1832.** The Miami Canal was to pass from Cincinnati northward along the Great Miami Valley, with the promise of its extension to Toledo in the near future, which promise was fulfilled in 1835. The population

* Andrews, *ibid.*, p. 381.

† Sterns, *ibid.*, p. 448.

‡ Niles' Register, 39: 139. Quoted from the *Rochester Daily Advertiser.*

§ Niles' Register, 47; 55.

‖ Hannah E. Keeth, "An Historical Sketch of Internal Improvements in Michigan, 1836–46." Publications of the Mich. Pol. Sci. Ass'n., Vol IV, No. 1, July, 1900, pp. 9, 12.

¶ "History of Ohio Canals," C. P. McClelland and C. C. Huntington. Published by the Ohio State Archæological and Historical Society. Columbus, O., 1905. Most of the facts relating to the Ohio Canals are taken from this book.

** Andrews, *ibid.*, p. 355.

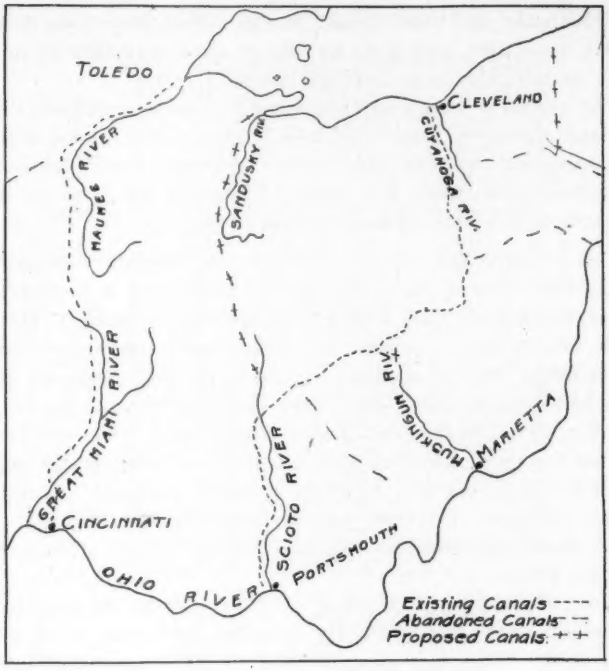


FIG. 21.

of Ohio was densest in the northeast, south, and southwest parts of the State, and this population was first served in canal construction. The favourable conditions of canal construction are reflected in the low average cost of construction per mile. According to De Bow, the cost and mileage of the Ohio canals were as follows:*

	LENGTH.	COST.	AVERAGE COST PER MILE.
Ohio Canal.....	334 mi.	$4,695,203.69	$14,055
Miami Canal...	85 mi.	1,237,552.16	14,441
Miami Canal (extension)....	139 mi.	2,856,635.66	20,551

The average cost per mile was lower than that of the Erie Canal and much lower than that of the Chesapeake and Ohio Canal. One feature due to the moderately high and comparatively level watershed in Ohio was more expensive and troublesome than that of the Erie

* De Bow's Review, 3: 133.

or Chesapeake and Ohio canals. Large storage reservoirs covering 32,903 acres and costing $1,430,222.07 were necessary to provide water to carry the canals over the divide.

The system of canals gave the surplus crops of much of Ohio an available market.* New York was a much better market than the fluctuating and distant market at New Orleans. Before the completion of the Ohio canals, flour sold at Cincinnati for $3.50 per barrel and at New York for $8.00 per barrel.†

THE ILLINOIS AND INDIANA CANALS.—As western Ohio and eastern Indiana filled up with settlers, the demand for a southwesterly connection between Lake Erie and the Ohio grew stronger. Here, as in the case of the Erie Canal, the physiographic conditions extended an invitation for such a canal. Some of the early marginal glacial lakes had an outlet past Fort Wayne, Ind., southwest to the Wabash (see Fig. 18). The physiographic conditions were even more favourable for this canal than they were for the Erie Canal, but the population was too sparse and the State too poor, promptly to carry the project through. The canal was building from 1832 to 1851, when the Wabash was connected with Lake Erie at Toledo. The average cost was $16,425 per mile.‡

Most of the flour and wheat of Ohio went to the East by the Lakes and Erie Canal, while the corn and pork went south by the Ohio River. The movements of flour by the canals at Cleveland and Toledo are shown in Figures 22 and 23. The maximum movement is seen to be in the decade 1850-60. The maximum revenue earned by the canals was reached somewhat earlier (Fig. 24). Considerable water power existed near the summit level, and this was available for manufacture along the canal zone.§ Akron, Massillon, and other manufacturing towns grew up in response to this water power.‖

Prices were equalized, the exports bringing a price determined by

* The width of the zone on each side of the canal through which the canal influence extended has been estimated at one hundred miles. "History of Ohio Canals," p. 128.

† Niles' Register, April 26, 1817, gives figures illustrating the difference in prices at ports on the lakes and at interior points.

Price of flour and corn per barrel at:

	SANDUSKY.	COLUMBUS.	CIRCLEVILLE.	CHILLICOTHE.
Flour.....	$15.00	$6.00	$6.50	....
Corn.....	1.50	.50	.37	$0.40

Niles' Register, 12: 144.

‡ Tenth Census, Vol. IV, Canals, p. 32.

§ In 1839 there was leased from the Ohio canals water to operate 207 pairs of four and a half feet mill stones. "History of Ohio Canals," p. 133.

‖ Semple, American History and Its Geographic Conditions, p. 271.

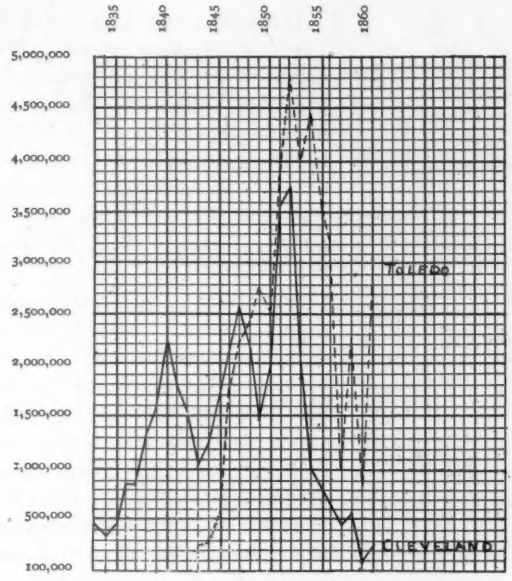


FIG. 22.—Graphs showing the number of bushels of wheat and corn arriving at Cleveland, 1833-60, and Toledo, 1843-60. For each port the graph represents the total number of bushels of wheat and corn added together.
From tables in the "History of Ohio Canals."

the foreign rather than the local demand, and the imports bringing lower prices in consequence of reduced cost of transportation.* In 1851, 90 per cent. of the flour and 50 per cent. of the wheat from this region was sent to New York.† Philadelphia and Baltimore lost the export trade of the region‡ and a zone of country ninety to one hundred and sixty miles wide was established tributary to the Erie Canal.§

The last important canal to open up the hinterland of New York was the Illinois and Michigan Canal, which was opened along the outlet channel of the glacial Lake Chicago in 1842. It was built too late to be successful in the developing competition of the railroads, and, of itself, added but little to the tonnage of the Erie Canal.‖

* For instance, wheat at Delphi, Ind., before the opening of the canal brought forty-five cents per bushel (1840), but two years later it brought one dollar per bushel. Before the opening of the canal in 1840, salt at the same place cost nine dollars per barrel, but in 1842 it cost only four dollars. Benton, *ibid.*, p. 109.

† *Ibid.*, p. 104. ‡ *Ibid.*, p. 105. § *Ibid.*, p. 97. ‖ Poor's Manual, 1881, p. xxiv.

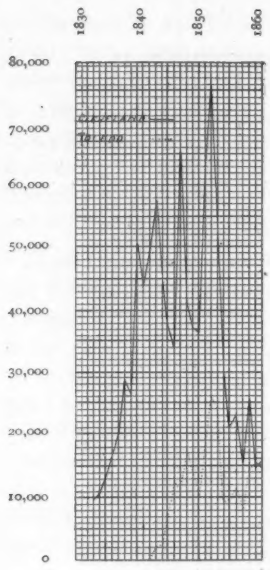


FIG. 23.—Graphs showing the number of barrels of flour arriving via the Ohio Canals at Cleveland, 1833–60, and Toledo, 1842–60. From tables in the "History of Ohio Canals."

INFLUENCE OF THE LARGER HINTERLAND UPON NEW YORK. — With the effective opening of this territory in the Upper Mississippi Valley, the commercial supremacy of New York was for the time assured. The Erie Canal offered the only practicable outlet to the sea, and New York was the only point of transfer from the Hudson to the Atlantic. In spite of decreasing tolls (Fig. 25), the revenue of the Erie Canal rapidly increased, and by 1845 the canal indebtedness was paid, the managers buying in the bonds at 20 per cent. premium.* In 1852 the canal was enlarged from a width of forty feet to seventy feet, and from a depth of four feet to seven feet. In 1882 the tolls were abolished. Up to this time, the total cost of construction had been $49,591,853, and the expense of maintenance $29,270,301, while the revenues were $121,461,871, thus leaving a surplus of $42,599,718.†

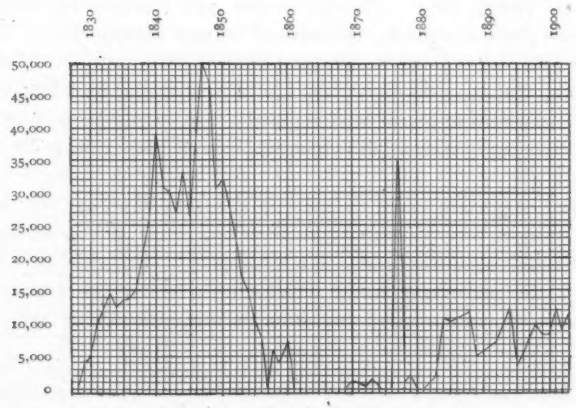


FIG. 24.—Receipts of the Ohio Canals, 1827–1903. From "History of Ohio Canals," page 170.

* *American Railroad Transportation*, E. R. Johnson, 1904, p. 30.

† Report on New York Canals, p. 151.

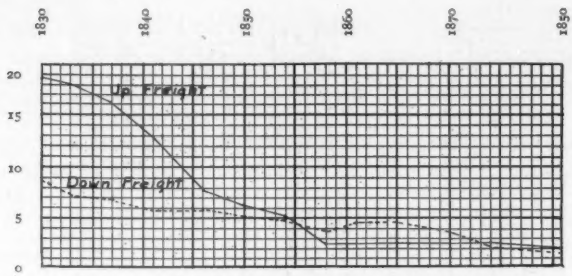


FIG. 25.—Average freight rates per ton on the Erie Canal, 1830–1881. From New York Report on Canals, page 192.

The through movement of wheat through the Erie Canal exceeded the local movement about 1839 (Fig. 26), while the through movement of all goods became predominant about seven years later (Fig. 27). The graphs tell the story of the rapidly developing hinterland of New York. If data were at hand and plotted, the imports at New York that were received for this hinterland would doubtless show a like increase. The nearly contemporaneous increase of immigrants and passengers entering New York (see Fig. 20) must be closely related to the development of New York's hinterland.

The tonnage cleared at the port of New York shows a somewhat lagging response to the increasing through canal traffic from 1840 to 1848.* But during that time the tonnage cleared at New York nearly quadrupled.

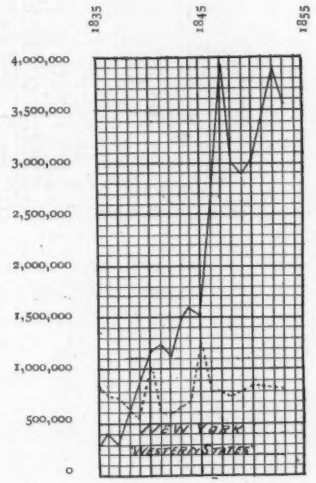


FIG. 26.—Movement of flour on the Erie Canal from "Western States" and from New York State from 1835 to 1853. One barrel of flour is assumed to be equivalent to five bushels of wheat. It is assumed that all wheat from "Western States" reached tidewater. The table, therefore, is of value chiefly as a comparison of the movement of wheat and wheat products during the time indicated. Solid line—flour from "Western States"; broken line—flour from New York State.
Report of Auditor of Canals of New York, 1854, page 11.

* Tonnage cleared at New York:

1826.....	227,857	1840.....	408,768	1855.....	1,445,754
1830.....	243,155	1845.....	483,525	1857.....	1,756,441
1835.....	366,389	1850.....	982,478	1858.....	1,460,998

Report of the New York Chamber of Commerce, 1858, p. 150.

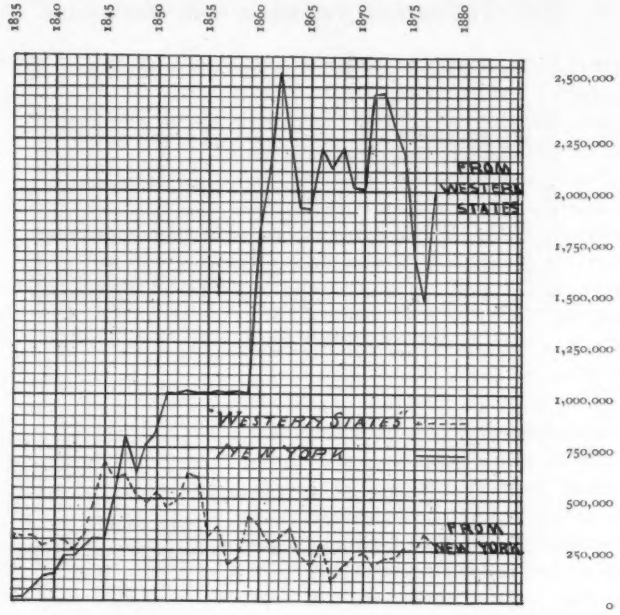


FIG. 27.—Tons arriving at tidewater via Erie Canal from Western States and from New York State.
From Report on New York Canals, pp. 169–170.

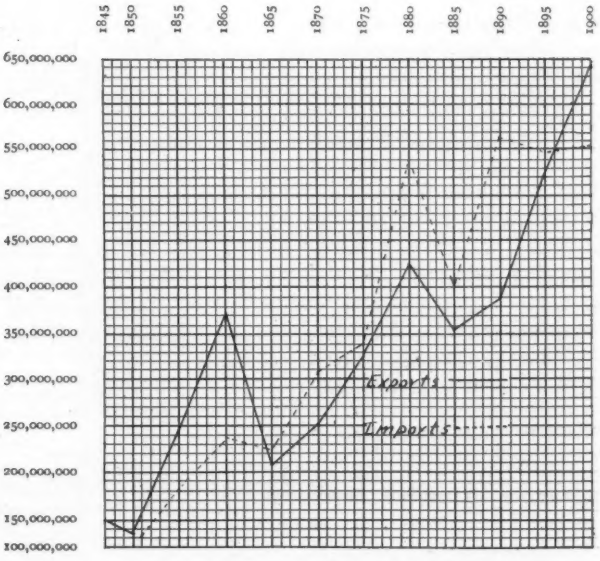


FIG. 28.—Value of exports and imports of New York, 1847–1900.
From reports of the New York Chamber of Commerce.

In the decade 1850-60 the value of the exports from New York increased rapidly and reached a point that was not exceeded until nearly twenty years later (Fig. 28). But during that decade the city had at least three lines of railroad connecting it with its western hinterland. From 1820 the population curve for the cities around New York harbour begins to rise faster (Fig. 29), and since

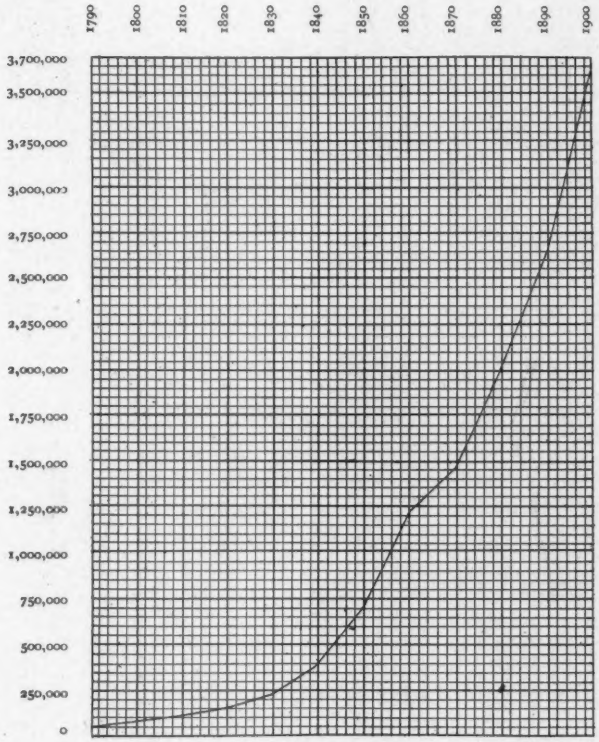


FIG. 29.—Population of New York and vicinity, including Brooklyn and Jersey City, 1790-1900. The figures for New York and vicinity, including Brooklyn, are estimates given in the 12th Census, Vol. I, part I, p. LXXX. The population of Jersey City is included from 1840 to 1900.

that time New York has led all other ports of entry for passengers and immigrants (see Fig. 20).

The close of the period of predominant canal influence in the United States, say, about 1855, found New York with a monopoly of

the trade of the Upper Mississippi Basin, which had become populous and wealthy. (Figs. 30 and 31.) It was estimated that in 1850, 5,403,595 persons, occupying 26,199,050 acres of improved land, were dependent on that port for much of their export and import

FIG. 30.—Population map in 1840. The dotted areas indicate a population of 18 to 45 per square mile, the lined areas a population of 45 to 90, and the dark areas a population of over 90.
From the Statistical Atlas, 12th Census.

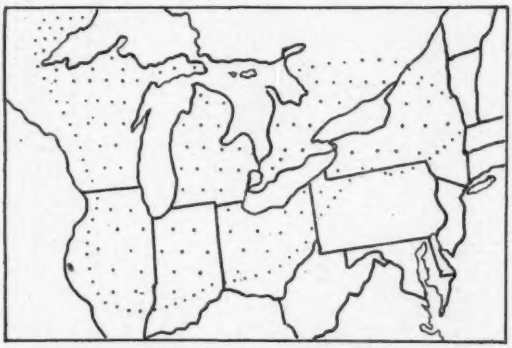


FIG. 31.—Map showing the territory estimated to be tributary to the Erie Canal in 1854 (the dotted area). From the Annual Report of the State Engineer of the Canals of New York, 1854.

trade.* The City of New York at that time had a population of 515,547; Philadelphia of 340,045; Boston of 136,811, and Baltimore of 169,054.

* Report of the New York Chamber of Commerce, 1862, p. 207.

(*To be continued.*)

THE SCOTTISH HIGHLANDS.

BY

RALPH S. TARR.

Finding myself in Great Britain in the summer of 1907, with about two weeks of unclaimed time, I decided to gratify a long-felt desire to tramp about in the Highlands of Scotland. My main object, aside from the desire to see the country in this way, was to examine the valleys in order to satisfy myself as to the evidence of glacial erosion in that region. In the course of these two weeks I covered several hundred miles, partly on foot, partly by steamer, and partly by rail. One of the points that impressed me most of all was the very marked influence of the surrounding conditions upon the people. The country has individuality and strength which must of necessity have stamped itself upon the character of the Scotch Highlanders.

The two physiographic elements whose effects upon the people are most prominent are the topography and the climate. In the Scottish Highlands the topography is one of marked relief. Being an ancient mountain system greatly worn, it consists of a variety of hard, crystalline rocks, often very massive. The dissection by water and by ice has cut deeply into the rocks, forming broad mountain valleys with steep sides, while between the valleys prominent mountains rise to elevations frequently of from three to four thousand feet; while in one instance, Ben Nevis, the elevation is 4,400 feet. It is a maturely dissected mountain region, modified greatly by glacial erosion.

The last stage in shaping this highland region was the work of the great glacier which spread out in all directions from the Scottish Highland centre. During the period of maximum glaciation, all of Scotland was covered by ice, and during this time it seems evident that the strong relief of the region guided the ice currents, causing more rapid flow along the major valleys. As the glacier was melting away, the continental stage was succeeded by a condition of dwindling glaciers whose valley tongues descended from a series of snow-field centres in the higher mountains.

The effects of this glacial occupation are numerous and important. In the first place, the ice removed the soil that had previously existed there, leaving bare rock surfaces in many places, which, in pre-

glacial times, must have been mantled with a soil of disintegration. Much of this soil, together with rock fragments ground from the mountains and valleys, was taken beyond the limits of the country and deposited in the surrounding sea. Some of it also found its way into the Lowlands of Scotland; but some, especially during the dwindling stages, was deposited in the form of moraines and gravels in the valleys. Some of the glacial soil is fairly level, making excellent farm land; but much of it is very rocky, including a large proportion of boulders plucked from the hard mountain rocks.

Besides this removal and deposition of soil, the glacier has accomplished a vast work of erosion. By it many of the valleys have been greatly deepened and their tributary valleys left hanging, often several hundred feet above the main valley bottom. The ice, sweeping across the divides, has lowered them, forming cols, and in some cases the divides have been so lowered as to connect different systems by a continuous through valley. In some cases the main valleys have been deepened several hundred feet by the process of glacial erosion, and in their bottoms water has gathered, forming the picturesque lochs for which Scotland is justly noted. Some of these lochs are in rock basins of glacial erosion; but many of them owe part of their depth to a dam of moraine, which, by interfering with drainage, has ponded back the water. Some of the lochs have fresh water, others salt, and the Scotch people have recognized the similarity of these two kinds of narrow, mountain-walled water bodies by giving them the name of loch. It is true that the indented Scotch coast, into which the salt-water lochs extend, is due in part to the sinking of the land, which has admitted the sea into the valleys; but in large measure the irregular coast has been moulded by glacial erosion, as the valleys of the interior have been.

Besides deepening the valleys by glacial erosion, there has been a steepening of their sides; for glacial erosion works laterally as well as vertically. This has planed off many of the valley spurs, leaving them truncated with steep cliffs. By this combined lateral and vertical erosion, the topography of the Scottish Highlands has had its ruggedness increased, and valley slopes that formerly were moderate are now so steepened that they cannot be occupied even for pasturage. Altogether, by the change in character of the soil, by the deepening of the valleys, and by the steepening of their sides, the effect of glacial occupation has been unfavourable to agriculture. It has done a damage which the local deposit of glacial soils has only partially repaired.

This rugged Highland region lies in the path of the stormy pre-

vailing west winds, with the result that the amount of clouds and rainfall is excessive. This is especially true on the higher land in the west, where the rainfall reaches over eighty inches in places. Day after day it is rainy or misty, especially on the higher slopes. Naturally, in this high latitude, the summer climate is cool, and, although so near the ocean, frosts occur late in the spring and early in the autumn.

Such a region must, of necessity, be sparsely settled. That the single factor of climate is not solely responsible for this is clearly indicated by the fact that the neighbouring Lowlands are densely settled and closely tilled. The sparse settlement, though due to climatic conditions in part, depends largely upon the rugged topography and the general lack of resources. Where the rainfall is not excessive, and the topography is less rugged, as along the eastern coast near and south of Inverness, there is a fairly dense population. Also, wherever there are valleys with fairly good soil, people are living by agriculture in considerable numbers, even in the most rugged part of the Highlands; as, for example, on the lake clay and gravel soils of the valley of Glen Roy, near the base of Ben Nevis. Wherever there are other kinds of resources, as in the granite region near Aberdeen, and along the coast where fishing supplies food, people live in numbers. Thus, a map representing the distribution of population in Scotland shows a coastal fringe of greater density than the interior; a still great density of population in the Lowlands, with its agricultural and mineral resources; and a considerable density along some of the larger valleys, like that of the Caledonian Canal, and on the lower, more fertile lands of the east coast.

Omitting these regions of greater density of population, and confining attention primarily to the more rugged Highlands themselves, and especially the western Highlands, we find the occupations of the people to be very simple, and their number not great. On the uplands there are large tracts where the soil is too thin for farming; and over many miles the bare rock is exposed. Even though the soil were good in these uplands, the season is too short for farming and the climate too damp. The Scotch mist encourages a luxuriant growth of swamp-loving plants here, not only on the more level tracts, but even on moderately steep slopes. The sphagnum moss and associated heather, and other plants, thrive here to such an extent that it would be difficult to farm this land even if the temperature permitted. While unfavourable to agriculture, the peat moss, which forms extensive bogs, furnishes a supply of fuel to the valley farmers. However, in most places the dampness is sufficient to cause

the development of extensive bogs even in the valleys, supplying the greater part of the demand of the sparse population.

The heather-covered upland, though useless for farming, is not wholly valueless, for it serves as pasture ground for immense numbers of sheep and is the home of the deer, grouse and rabbits, which are allowed to live here for the sport of the hunters. One of the important industries of the uplands is that connected with hunting, including personal service on the estates.

It is sheep-raising, however, that is the fundamentally important industry of the Scottish Highlands. In all Scotland, there are about four and a half million people, most of whom live in the Lowlands; but there are twenty-five million sheep, the larger number of which are in the Highlands. Four million acres in Scotland are uncultivated, and there are nine million acres of heather, while a little less than five million acres, a very large part of which is in the Lowlands, are given over to crops and grass; 21.9% of the surface is uncultivated; 40.4% is heather, etc.; and 25.2% is cultivated.

Although the greater part of the Scottish Highlands is either in heather or else utterly worthless, there is some agriculture in the valleys. Indeed, farming is undertaken even in some of the narrow valleys with rugged morainic soil; while in many of the broader valleys there are fairly extensive farms. But in these Highland valleys there is not only soil limitation, but also limitation of agriculture due to unfavourable climatic conditions. The dampness makes it difficult to dry the hay and the grain, and the shortness of the season and the prevailing cloudiness interfere with the maturing of these crops. In the western Highlands frost occurs late in August; and in the season of 1907 oats were not yet ripe on many of the farms, and grass was uncut as late as the 10th of September. There was a notable difference in this respect from place to place, but throughout much of the Highland region the grain crop for that year did not promise to yield very great returns.

The uneven, rugged, mountain masses of the Scottish Highlands have greatly interfered with communication across country, and have encouraged the development of clans. This, together with the economic poverty of the region, tended toward that isolation which so long maintained the independence of the Highlanders. One may still see the kilt worn in the more remote districts, and the Keltic language is not uncommonly heard. Even at the railway station of some of the new lines that have pushed their way into the more remote Highlands one may hear Keltic spoken.

The effect of glaciation has somewhat diminished the degree of

isolation of the various parts of this region. Passes have been lowered by the ice scouring so that they are more easy to cross; and by glacial action lakes have been formed which served as highways of early Highland travel, as they do at the present time. Where the trails of the Highlanders extend through the valleys that are modified by glacial erosion, roads have more recently been built, and, in some places, even railroads. Now an ever-increasing tourist business, making use of the roads and lochs, has developed.

Among the highways into the Highlands, none equals in importance that of the great valley occupied by the Caledonian Canal. This is a wonderful natural highway, depending in the first place upon a line of faulting across the Highlands, and, in the second place, upon the enlargement of the depression by stream, and later by glacial erosion. The passage of ice along this valley has steepened its sides, lowered its bottom, and, on the recession of the glacier, has left a series of navigable and very beautiful lochs. At considerable expense the gaps between the lochs have been crossed by canals; but this ambitious enterprise was foredoomed to commercial failure by reason of the fact that the highway traverses an unproductive region, and, furthermore, by the fact that the Caledonian Canal really leads nowhere. To-day it has degenerated largely into a mere tourist highway, far-famed for the grandeur of its unique and typically Scottish scenery.

Although the Lowlands of Scotland have come to be a very important manufacturing centre, the Highlands have practically no manufacturing. One reason, of course, is that there is no coal, and that it is difficult to bring this heavy fuel into the mountain valleys. A second reason is that there is practically nothing to manufacture excepting wool and grain. The former, scattered widely over the Highlands, is most easily gathered into small lots for shipment to the Lowlands and elsewhere. The latter is locally manufactured to some extent; and among the most notable of the manufactories of the Scottish Highlands are the whiskey distilleries.

While coal is absent, there is an abundance of water power. The heavy rainfall of this damp climate supplies plenty of water, and in numerous places this falls out of the hanging tributary valleys, cascading down the ice-steepened slopes of the main valleys. But this water-power, due largely to glacial action, is for the most part, allowed to run to waste; for there is almost no local use for it.

The few people who dwell in this unproductive region show distinct evidence of the influence of the surroundings upon their very character. The persistence and frugality of the "canny Scots," of

which the Englishman often complains, find ample explanation in the surrounding conditions. It seems, of necessity, that they must overwork and undereat, both of which conditions would tend toward persistence and frugality, as well as toward the development of strong will, for which the Scotch are also noted. The Highlander seems to be stolid, in some cases even to the extent of stupidity. He is unimaginative, and lacks buoyancy of spirit. These facts were often brought out clearly when attempts were made to enter into casual conversation with the peasantry. Frequently, a passing "good morning" brought either no reply, or at most, a grunt, or a nod. There seemed little evidence of the presence of generous disposition; and, in fact, there was little reason for expecting such a disposition under the conditions amidst which they lived.

On almost every hand there was clear evidence of a general lack of enterprise; and surely, with such surroundings, there is little basis for development of a high degree of enterprise. This condition finds many illustrations in numerous directions, though perhaps in no way better than that supplied at the tourist resorts. Here, often in villages of a fair size, neither telephone nor electric lights were to be found, and at many of the large, well-patronized summer hotels, one was forced to light his way to his chamber by use of the candle, although from the window of the room one looked out upon a noisy waterfall, which, at slight expense, could have been made to develop the necessary power for electricity. Perhaps in our own country we are over-prodigal in the production of this kind of luxury; but, whether this be so or not, the Scotch are surely very backward in their development of what Americans have come to consider almost necessities.

One is struck by the physique of the Scottish Highlander. This fact finds ready explanation in the necessary continued physical exercise and in the probable elimination of the weaker members under such severe conditions of life. Altogether, a visit to the Scottish Highlands leaves, as one of its most distinct impressions, the conclusion that this is, geographically, just the region for such deeds as Scottish history records, as well as for the Presbyterian reaction from it. It is, moreover, an excellent training ground for a race of people qualified by physical strength and mental development for successful competition in other regions offering greater opportunities than this rock-bound country of clouds and mists.

GEOGRAPHICAL RECORD.

AFRICA.

THE FOREST REGION OF MOUNT KENIA.—Mr. E. Hutchins, Chief Conservator of Forests, and Mr. Ross, Director of Public Works in British East Africa, have recently returned from a tour around the Kenia forests and a visit to the glaciers. Ken a is the only snowy mountain in the Old World lying exactly on the equator. Its height is 17,150 feet; it has 15 glaciers and it is the culminating point of the richest part of British East Africa. The following facts concerning these latest studies on the mountain are condensed from the account published by *Nature* (Nov. 26, 1908).

A journey occupying nearly two months was made almost completely around the mountain and for the most part at the Alpine altitude of 12,000 feet. The purpose was to ascertain the extent and value of the mountain's great forest girdle. It was most convenient to travel at this altitude to avoid the tussock grass, which grows thickly in bunches three to four feet high; and progress through this is not easy in the wet season when it is covered with half-frozen rain and hail. This grass extends above the upper forest region; and above the tussock is a zone of shorter grass, with the heath tree, *Erica arborea,* supplying firewood and marking the upper limit of tree growth on the mountain.

A persistent northeast air current was found above the mountain at about 20,000 feet. Between 7,000 and 14,000 feet the atmosphere was singularly calm and serene. Below 7,000 feet and on the plains away from the mountain the southeast trades blew strongly by day. On the northern highlands, at about 10,000 feet elevation, the climate was curiously mild and equable. It was not only pleasant and healthful, but also very exhilarating. There was little or no frost, the small amount of rain came mostly at night, and by day the equatorial sun was usually screened by a thick mantle of cloud. This elevated plateau is very beautiful and is eminently a white man's country.

The whole of the Kenia Alpine region is healthful and invigorating, but there is a great contrast for half the year between the wet and misty southern slopes and the dry, bracing plateau country of northern Kenia. Hail was often experienced and daily on the wetter south side of the mountain. There was only one snowstorm, the snow falling in light flakes for several hours. For some miles around the glaciers a light mantle of snow covered the ground, but it rapidly melted under the influence of a little sun and the warmer air prevailing during the day at the higher altitudes. The peak was bare of snow on the northeastern side, presumably on account of this comparatively warm upper current. These observations have peculiar value, as they were made at the wettest time of the year—April, May and June. The explorers found, at Alpine elevations, the southern side in April and May dripping with moisture and the air nearly saturated with it most of the time. A part of this side was too wet for the upper traverse and the forest had to be mapped from below only.

Everywhere else the forest was examined from above and below, and sample areas of the timber were measured. The forest is practically continuous around the mountain, with only one break about eight miles wide. The average width

of the forest belt is from six to nine miles. On the north and west sides, where the forest belt is thinnest, the quality is best, consisting largely of cedar, which is found only in the drier forest. Ibean camphor is abundant in the great recess in the mountain on its southeastern side, but cedar fails there. In the drier parts of the mountain the bamboo belt is much reduced in breadth, is frequently broken and sometimes absent.

The most valuable timbers are Ibean camphor on the wet, southeastern side, and cedar, *Juniperus procera,* on the drier western and northern sides. The former is a timber of exceptional value. Its botanical name has not yet been determined, as its flower has now been seen for the first time; but the cedar is a loftier and far more abundant tree than the camphor. It runs up in straight stems to over 100 feet, and one tree was found on northern Kenia nearly 12 feet in diameter. The forest is richly stored with cedar, not only with the living tree but also with the dry and sound timber of past ages. Fire, however, does great damage in these cedar forests. The most abundant timber is yellowwood, *Podocarpus thunbergii,* var. *milanjianus,* which differs little from the well-known yellowwood of South Africa. The finest timber is in the southeastern recess, but this is largely composed of hardwoods, which have not the same value as the camphor and the conifers.

Deforestation and Climate in Mauritius.—On the Island of Mauritius there has been much deforestation since 1850. In that year about one-third of the area of the island was covered with trees. In 1880 forests covered only about one-tenth. Several authorities have expressed the opinion that this deforestation has brought about a change in the climate of Mauritius. This subject has recently been investigated by Mr. A. Walter, chief assistant of the Royal Alfred Observatory, who has made a thorough examination of all available data in order to find evidence either for or against the view of an influence of deforestation upon climate ("On the Influence of Forests on Rainfall and the Probable Effect of Déboisement on Agriculture in Mauritius"). The smoothed rainfall curves for 1860-1907 seem to Mr. Walter to give evidence that the cutting of the forests may have had some effect, although a very small one, on the total rainfall, but that the effect has been greater in the case of the number of rainy days. The rainy days in the districts denuded of forests have been decreased by about thirty a year, but under such conditions that the amount due to these thirty days is only about 6 to 10 inches, whereas the annual variation of the total rainfall is often 60 inches. Before deforestation, "rain fell on many calm afternoons, because the presence of the moisture transpired by the trees was sufficient, by increasing the humidity and decreasing the pressure, to cause slight showers." The rains thus caused are, however, very local, and the author of this paper does not recommend any great work or expense in planting trees with the idea of improving the climate generally.

R. DeC. W.

AMERICA.

The Society's Geographical Exhibition.—During the past few months the Society has received from the leading European countries a considerable number of specimens of the wall maps, atlases and text-books used abroad in geographical education. The collection was made in the belief that the examination and

study of such material would be educational and helpful to American teachers of geography, and that the work would be in line with the efforts of many of our foremost teachers whose influence is now continuously felt in behalf of the further improvement of geographical instruction in our country. The collection was confined to foreign material, as it was especially desired to give our teachers and students an opportunity to examine typical specimens of school maps and atlases which are not easily accessible to them.

The collection is not a large one, but it fully represents the best grades of school wall maps, atlases, etc., produced in Europe. The German wall maps, for example, are among those in use not only in the middle and higher schools, but also in the university lecture courses.

The exhibition was opened in the house of the Society on Dec. 21. The catalogue of the material is intended to be helpful in the examination of the exhibits. While a special invitation has been extended to teachers, any person who is interested is invited to visit the exhibition rooms. After the exhibition closes in New York the collection will be seen in other educational centres of the country.

INTERPRETATION OF TOPOGRAPHIC MAPS.—The U. S. Geological Survey has just issued as Professional Paper 60 a report entitled "The Interpretation of Topographic Maps," by Professor R. D. Salisbury of the University of Chicago and Mr. W. W. Atwood of the Survey. The purpose is to bring the sheets of the Topographic Map more prominently before teachers of geography and geology. The volume contains about 170 sheets from the maps and folios of the Survey, some of them accompanied by photographs or sketches of various features mapped in contours. Each map represents some special topographic type and the maps as a whole illustrate all the more common and important phases of topography. Nearly every State and Territory is represented in the collection. The text accompanying the maps describes the development of the phases of topography shown, and is prepared for those who are not familiar with such maps, but who understand the meaning of technical terms used in recent text-books of geology and physiography. It is believed that the text is sufficiently full to enable any one with such knowledge to understand the maps and that the study of the whole series will fit the student to understand and interpret other maps.

THE WATER RESOURCES INVESTIGATION.—The annual *Report* of the Director of the U. S. Geological Survey, now in press, emphasizes the need of continuing the work of determining the extent and character of the water resources of the country. The Director says that the work done in this line is not commensurate with similar surveys in many European countries. If we were to study this question as thoroughly as is being done in Switzerland, we should appropriate $11,000,000 a year, which is 110 times as much as our present annual appropriation.

The average annual damage by floods in this country is about $100,000,000. In many parts of the United States the wise expenditure of one year's flood-loss in these regions would prevent future floods. In other parts of the country the cost of prevention would probably equal the flood loss for two or more years. Most of the rivers are inter-State and the prevention of floods can be accomplished only under Federal authority.

The Government has expended several hundred million dollars for river improvement and as much or more must probably be disbursed in the next decade.

All engineers agree that a thorough investigation of rivers is necessary to decide how these improvements shall be made.

The country is spending $40,000,000 in the construction of irrigation systems, but whether there is water for these projects cannot be determined by measurements made over a short period of years. When work was begun in 1902 the Government was able to proceed at once with certain projects, because the Survey had the results of stream measurements showing that sufficient water was available for the initial projects. It would obviously be unjust to charge the cost of general investigations over all the arid West against specific projects.

The Director also calls attention to the fact that over 80,000,000 acres of the best agricultural lands in the country are unproductive because they need drainage. The investigation of water resources, and topographic mapping are as necessary for the success of this work as for the success of irrigation enterprises.

New Oil Field in Mexico.—In the State of Vera Cruz, sixty-seven miles from Tampico and in the gulf coastal plain region, a phenomenal oil find has been made, the development of which was accompanied by some remarkable results noted by R. H. Millward, American Vice-Consul at Tampico, Mexico, in the *Nat. Geog. Magazine,* Nov., 1908, pp. 803-805. The two wells now drilled are at San Gerónimo and reach depths of 2,000 feet and 1,800 feet. In the 1,800-foot well oil was discovered under such pressure that it could not be controlled. The deluge of oil became ignited from the boiler fire and approximately 60,000 to 70,000 barrels of oil were consumed daily from July 4th to August 30th, when the fire was finally conquered. The total cost of development work and loss by fire aggregates more than $3,000,000. Newspapers could be read at night by the light of the column of fire a distance of 17 miles, headlines at 33 miles, and ships' officers reported the light visible for more than 100 miles at sea. The oil is now impounded in a lake of great extent and will soon be properly controlled and delivered by pipe lines. This discovery is of unusual importance for two reasons: first, it occurs near the seacoast whence ocean shipments in oil vessels can easily be made from Tampico, to which port pipe lines from the wells can easily be constructed; second, the coal deposits of Mexico unfortunately do not occur near the great railway transportation lines and have been but little developed in the past. Coal is received in certain quantities from the United States, and the cost of all fuel is inordinately high. The economic value of such finds is correspondingly enhanced, especially as many of the railway locomotives of Mexico are now operated with oil fuel obtained in large quantities from the Texas and California oil fields. I. B.

The Economic Progress of Entre Rios.—The Argentine province of Entre Rios lies north of Buenos Aires, between the Paraná and Uruguay rivers, a delta region with great pastoral and agricultural possibilities. Its financial and economical conditions are described in the annual message of its Governor to the Legislature and reported in the U. S. Daily Consular and Trade Reports (Oct. 17, 1908, No. 3307). A ferry-boat railway recently completed places Entre Rios in close communication with Buenos Aires and greatly facilitates commerce between them. The cattle of the region are unfortunately still of inferior quality and suffer much from the ticks and red murrain. The first serious effort to reduce the effects of cattle diseases is being made by the director of the National Bacte-

riological Institute, Professor Lignieres, who will travel through the most important pastoral regions and lecture on the means to be adopted to prevent and cure the diseases. The province has about 3,200,000 head of cattle, 7,000,000 head of sheep, and 500,000 horses.

Their products, with those of the poultry business, are estimated at about $15,000,000 a year. These statistics and estimates are a sufficient index of the importance of this rapidly growing eastern province of the Argentine.

The nearness of the province to the sea and its eastern position far from the Andes alike favour increased rainfall from the monsoons of summer and the cyclonic rains of the westerlies in winter. In consequence, agriculture thrives without irrigation. About a million and a half acres are under cultivation, of which nearly one-half is devoted to wheat, a half million acres to linseed, and the rest to alfalfa, peanuts, vines, and fruits. The production of wheat is estimated at a ton per two and a half acres. The total value of the agricultural products is about $18,000,000. The total population numbers nearly a half million, of which 70 per cent., an unusual number for Argentina, live in the country.

I. B.

THE PASTORAL INDUSTRY OF BRAZIL.—The two great crops of Brazil, coffee and rubber, have drawn public attention away from cattle raising, which promises to be one of the chief industries of that country in the near future. Thousands of square miles of fine grazing lands occur in the southern part of the republic and extend north to the uplands along the southern tributaries of the Amazon. In spite of the advantage of these well-watered pastures, Brazil has until recent years been a large importer of dairy products, particularly butter and cheese. Even to-day such is the case in the northern parts of the country, where either the climate makes stock-raising and dairying impossible or the energies of the population are wholly absorbed in other industries. In early colonial time the inhabitants of this tract obtained their subsistence very largely from the more or less wild herds of native cattle. Although the industry has since then increased in an absolute sense it has declined relatively, being quite overshadowed by coffee and rubber. The great crises which the latter industries are experiencing have turned Government attention to other agricultural activities, the diversification of crops, and the encouragement of the pastoral industries by the importation of blooded stock for better breeding results.

The demand for dairy products in the large cities has also encouraged the extension and improvement of dairying and cattle raising. (See Daily Consular and Trade Report for Nov. 6, 1908.) Less than ten years ago it was all but impossible to buy a glass of fresh milk in any shop in Rio de Janeiro. Cows were driven through the streets and milked at the doors of the people who wished to buy. The custom persists in some cities to-day. Butter for the use of the inhabitants was imported in some quantities from the remote interior. Even at present the meat supply of the cities of Rio de Janeiro and São Paulo is derived from the herds grazing over the thinly populated and all but unknown States of Goyaz and Matto Grosso, whence the cattle are driven for more than a thousand miles, sometimes to make connections with railroads, sometimes to be shipped on river boats down tributaries of the River Plate system and up the coast to Rio. Cattle-raising in these States is conducted upon a very extended scale. There are several ranches in the southern part of Matto Grosso that are hundreds of square miles in extent, supporting herds of 120,000 to 200,000 head. Within the

borders of Matto Grosso alone there are not less than 3,000,000 cattle, and Goyaz has but slightly less.

Difficult transportation, in a region where the high temperatures make cattle-driving over these long distances precarious, is one of the first things to be overcome. The situation is not at all unlike that in Texas and Oklahoma after the Civil War, when cattle were driven over long trails to the termini of the railroads building west of St. Louis. The Northwest Railroad of Brazil, now in construction, will be the first to tap the region and will bring the grazing lands of western Brazil within reach of the markets of eastern Brazil. The effect will be further to diminish the imports of meat and dairy products to the correspondingly greater encouragement of the grazing industry of Brazil.

The herds of Brazil are subject to peculiar difficulties, in spite of the absence of inclement weather and the year-round grazing that is possible. In Bahia and along the coast, even beyond the mouth of the Amazon, there are frequent and prolonged droughts (due to the correspondence of direction of trade winds and coastal uplands), and these occasion heavy losses both to farmers and to cattlemen. The greatest obstacle common to all grazing lands in the country is the many cattle diseases. In Minas Geraes in 1905 official figures indicated losses amounting to 426,374 head, as compared with 303,918 slaughtered for food purposes.

I. B.

ASIA.

PEKING AND CANTON RAILROAD.—While the proposed railroad between Peking and Canton was completed between the Capital and Hankow, 753 miles, towards the end of 1905, little has yet been done towards the extension of the line south of the Yangtse River to Canton. A Chinese imperial edict issued on July 18 last, forwarded to Washington by Minister Rockhill, directed Chang Chih-tung, Grand Councillor, to assume absolute control of the building of the Hankow-Canton section, adding that the divergent policies advocated by those in charge of the work had prevented substantial progress in construction and an official was now appointed in supreme control so that the line might be completed without needless delay.

PLAGUE AND CLIMATE.—The conclusions regarding the relation of plague to weather conditions are almost as numerous as are those who have investigated this subject, but it is clear that plague is not strictly limited by isotherms, and that meteorological conditions do not alone spread it, or control it. The Indian Plague Commission, a few years ago, concluded that there is no direct relation between plague and climate. Hirsch had previously stated that the relation is unsettled. In the tropics, however, the disease has, as a general rule, had a cool-season, and in higher latitudes a warm-season, maximum. On the whole, plague has chiefly prevailed under moderately high temperatures and moisture conditions, and where the soil is damp and the ground low. These facts do not, however, necessarily point to cause and effect. A recent report on plague investigations in India (*Journal of Hygiene*, Vol. VIII, No. 2, May, 1908), states the following conclusions: (1) A plague epidemic is checked when the mean daily temperature passes above 80° Fahr., and especially when it reaches 85° or 90.° (2) A mean temperature above 80° affects the conditions to which the plague bacillus is subjected in the stomach of the flea. At high temperature, about 90,°

the plague bacilli disappear from the stomach of the flea much more quickly than at lower temperatures, namely, between 70° and 80.° (3) A plague epidemic may, however, come to an end when the temperature is most suitable. Other factors must, therefore, be present in these cases. R. DEC. W.

OCEANIA.

DR. DORSEY'S MISSION.—Dr. George A. Dorsey, Curator of anthropology in the Field Columbian Museum, Chicago, left London at the beginning of this year on an eighteen months' scientific mission in the South Pacific and on the coasts of Asia. Letters from him which have been noticed in the press, say that he had arrived in Manila from German New Guinea, having called at the Caroline Islands on his way. While in New Guinea he visited more than thirty Papuan villages between Friedrich Wilhelmshafen and the Dutch boundary, including several villages of the Schouten and other islands along the coast. He also ascended the Kaiserin Augusta River for 100 miles, visiting villages whose inhabitants were totally unacquainted with white men except by tradition. In this part of his journey, Dr. Dorsey made a valuable collection of more than 2,000 specimens, mostly in New Guinea. He studied the museums of Melbourne and Sydney, and crossed Bongainville Island. On the 11th of December he landed at San Francisco on his way home.

POLAR.

CAPTAIN AMUNDSEN'S NEXT EXPEDITION.—This explorer expects to leave Norway in the spring of 1910 for the purpose of putting his vessel into the ice of the Arctic Ocean north of Point Barrow, Alaska, with the expectation of drifting for a number of years across the polar area. Nansen's ship, the *Fram*, has been placed at his disposal, and King Haakon has headed the public subscription for his enterprise with a donation of $5,000. In a lecture which Captain Amundsen recently delivered in Christiania he is reported to have said in part:

We shall start for San Francisco, going around Cape Horn. At San Francisco coal and provisions will be taken on board. From there we will set out for Cape Barrow, where I hope to arrive in July or August. From Cape Barrow I shall start with the smallest possible crew. The course of the drift ice is northwest. We shall try to enter the compact ice at the most favorable point to begin our drift over the polar basin, which I calculate will last four or five years. During all that time we shall make oceanographic and other observations, through which I hope to solve some of the yet unexplained problems of the polar regions.

We have apparatus now by which it is possible to obtain samples not only of the surface of the bottom, but also of the underlying strata at a depth of two metres or more. Perhaps of even greater importance, however, is the examination of the temperature of the water in the different depths of the sea. We are now able to measure it with exactness at any depth. We know now of three different water-bulks in the polar basin; they represent at the least three different current systems, which are not yet sufficiently examined. We will be able to do it through the pendulum-current measure apparatus of Nansen and the propeller-current-measure apparatus of Dr. Ekborn, both invented within the last four or five years.

Another insufficiently examined problem is the existence of tidal waves and tidal currents in the polar basin, a question of great importance, not only to science, but to navigation as well. Other problems to be examined are the influence of the winds on the currents of the sea, the quantity of air and gases in the sea and their importance to organic life, the role of the light in the different depths below the ice, and a series of further questions which will elucidate the physiology of the sea and the circulation of organic life.

We have no ambition to make a record in the struggle for reaching the geographical pole. The object of my expedition is to scientifically examine the polar basin, its bottom and configuration and the different oceanographic problems in connection with it.

ANTARCTIC METEOROLOGY OF THE "DISCOVERY" EXPEDITION.—The meteorological work of the British National Antarctic Expedition, 1901-1904, has been published as *Meteorology, Part I. Observations at Winter Quarters and on Sledge Journeys, with Discussions by Various Authors* (London, Published by the Royal Society, 1908). The *Discovery* wintered in lat. 77° 50′ 50″ South, long. 166° 55′ 45″ East. The observations are unique in that they were continuous over a period of two years. The mean temperature was —1.7°. The lowest mean temperature for any one month was —21.1° (July, 1903), and the highest mean temperature 26.1° (January, 1903). The absolute maximum was 39° in the first year and 42° in the second, both in December. The absolute minimum was —50.5° in the first year and —58.5° in the second. The lowest temperature actually noted was at Cape Armitage, May 16, 1903, when the spirit minimum registered —67.7°. Fluctuations of temperature were rapid and violent at all seasons. An increase of temperature, especially in the winter, was associated with a wind from the pole. The summers were very cold, only a few days giving a mean temperature above freezing. This low summer temperature is distinctly characteristic of the Antarctic, and is brought out in all the reports of the recent Antarctic expeditions. The surface winds were chiefly easterly, as they were on the German ship *Gauss*.

R. DEC. W.

DR. CHARCOT'S VOYAGE TO THE ANTARCTIC.—The Antarctic expedition in the steamer *Pourquoi Pas* arrived at Rio de Janeiro on Oct. 12, where it remained for a week. The scientific staff was honoured with a reception by the Geographical Society. At last accounts the expedition was on the way down the coast to Buenos Aires (which it left on Nov. 23), Punta Arenas and Ushuaia in Tierra del Fuego, and from this mission station Dr. Charcot expected to go south to Loubet Land, which he discovered in 1905, and then proceed further south to Alexander Land.

DR. FREDERICK A. COOK.—When Commander Peary's auxiliary steamer *Erik* returned home last fall she brought Mr. Randolf Francke, who had been Dr. Cook's only white companion at Annatok on the northwest coast of Greenland during the winter of 1907-08. Annatok is nearly opposite the northern entrance to Smith Sound, about 20 miles north of Etah. Dr. Cook had left New York in the summer of 1907 ostensibly on a hunting trip, but when his vessel returned it was reported that his real purpose was to attempt to reach the North Pole.

Mr. Francke says that on March 3 last Dr. Cook left his camp at Annatok with eight Eskimos, four sledges, twelve dog teams, and a good supply of food, and went inland in Grinnell Land towards the Arctic Ocean. The only news heard of him later was a letter dated March 7, two weeks after his start, telling Francke that if he did not return to Annatok by early June to go back to New York at the first opportunity. He added that he was on the west coast of Grinnell Land, making his way north. As he did not return early in June, Francke attempted to reach Cape York in the south, as he might meet a whaler there; but he was compelled to turn back owing to the bad travelling and was picked up by the *Erik* at Etah. Nothing is known of Dr. Cook's fortunes, but Capt. Bartlett of the *Erik* thinks he is probably safe in Ellesmere Land, where there is plenty of game, including musk oxen.

VARIOUS.

AMONG THE PAPERS read at the meeting of the National Academy of Sciences at the Johns Hopkins University, Baltimore, on Nov. 17 and 18, was one by Henry F. Osborn on "The Close of the Cretaceous and Beginning of the Eocene in the Hell Creek Region of Montana," based on explorations between 1902 and 1908; one by Alexander Agassiz on "The Work of the U. S. Fish Commission Ship *Albatross*"; and one by C. R. Van Hise on "The Phosphates of the Soil."

MR. AND MRS. WALDEMAR JOCHELSON are on their way to the Aleutian Islands to make ethnological studies under the auspices of the Imperial Russian Geographical Society. They were both members of the Jesup North Pacific expedition, and before departing on their latest journey spent the month of October in this city making studies of some of the Alaskan material in the American Museum of Natural History; and Mr. Jochelson also consulted the literature of the subject in the library of the American Geographical Society. They intend, after completing their work in the Aleutian Islands, to devote a year to similar studies in Kamchatka.

THE ROYAL SOCIETY, the Royal Geographical Society and Trinity House will defray the expense of a memorial to the late Sir Leopold McClintock in Westminster Abbey.

A COMMITTEE of the British Empire League in London has been appointed to have charge of the movement for the erection of a monument in that city to commemorate the great services to the Empire of Captain Cook, the celebrated navigator and explorer.

PRESIDENT ROOSEVELT, in reply to an invitation sent him by the President of the Royal Geographical Society, has promised to address the Society after his arrival in England from his African journey, about April, 1910.

THE AMERICAN GEOGRAPHICAL SOCIETY.—A Regular Meeting of the Society was held at the Engineering Societies' Building, No. 29 West Thirty-ninth Street, on Tuesday, November 24, 1908, at 8.30 o'clock P. M.

President Huntington in the chair.

The following persons, recommended by the Council, were elected to Fellowship:

Rufus Lewis Perry,
Edmund Mortimer,
M. M. Campbell,
George W. Wickersham,
Sandon Perkins,
Harry V. Radford,
A. Benedetti d'Altomonte,
Fanning C. T. Beck,
Carroll Bryce,
Howard Crosby Butler,
Henry Brevoort Cannon.

The President, coming forward, spoke as follows:

"MEMBERS OF THE COUNCIL OF THE AMERICAN GEOGRAPHICAL SOCIETY, LADIES AND GENTLEMEN:

It is my privilege to present to the American Geographical Society this evening a brother geographer, of whose work we all know something, and whose

reputation makes his presence among us, not only a personal gratification to each of us, but a personal honor.

Dr. Albrecht Penck is the Professor of Geography in the University of Berlin; Director of the Geographical Institute of the Museum of Oceanography. His life has been dedicated to the study of geology and geography and he is among the foremost authorities on these sciences. At the age of 20 he explored the unstratified deposits of North Germany and the glaciers of Norway, and later pursued the study of glaciation in the German Alps. In 1883 he settled in Munich, and in that same year travelled in Scotland and to the Pyrenees, where he examined the evidences of the Ice Age. In 1885 he accepted the chair of Physical Geography in the University of Vienna. To this time belong his labours on the influence of climate on the surface of the earth and on the men of the Ice Age. In 1891 at the International Geographical Congress at Berne, he proposed the plan of a map of the world on the scale of 1:1,000,000, and was charged with the supervision of the work, since steadily continued. We may judge from the works of such a man how vague are the borderlands of the science of geography, how vast the field they may be made to touch upon and to comprehend. The great geographer must be first a great scientist and his grasp of his subject is bounded only by the limitations of genius itself.

In these days, it is the peculiar privilege of those who live closely within the walls of civilization, to come easily to a friendship and understanding with the adventurous ones who give their lives in the cause of knowledge. To-night we are fortunate in meeting one who has looked with the calm insight of science upon places charged with the older mysteries of the earth; who has returned to us moved, yet undismayed, to set before us calmly the nobler secrets of nature, and with that sublime truth which is the heritage of the scientist."

President Huntington then introduced Dr. Penck, who addressed the Society on "The Origin of the Alps." Illustrations by lantern-slides were shown.

On motion, the Society adjourned.

OBITUARY.

Dr. Otis Tufts Mason.—This eminent anthropologist, widely known to students of that science, and Head Curator of the Department of Anthropology in the U. S. National Museum, died in Washington, November 5, at the age of 70 years.

NEW MAPS.

AFRICA.

Algeria.—Département d'Oran. Carte des Voies de Communication. Scale, 1:400,000 or 6.3 statute miles to an inch. With inset of Sud Oranais, scale, 1:2,000,000, or 31.56 statute miles to an inch. Dressée par ordre de M. C. Jonnart, Gouverneur Général. Département d'Oran, 1908.

Shows in colours, towns, villages, colonization centres, wide and narrow gauge railroads in operation, in construction or projected, national highways and common roads, river navigation and lighthouses with radii of illumination. Distances on rail and national routes are marked at every 10 kilometers.

ALGERIA.—Carte du Département d'Oran. Scale, 1:400,000, or 6.3 statute miles to an inch. Inset of Aïn-Sefra, scale, 1:3,200,000, or 50 statute miles to an inch. Dressée par ordre de M. Jonnart, Gouverneur Général, par le Service Topographique. Oran, 1907.

In colours with large nomenclature, boundaries of Department, Arrondissements, Communes, etc., centres of colonization, rail and national routes, and government forests.

AMERICA.

UNITED STATES GEOLOGICAL SURVEY MAPS.

TOPOGRAPHIC SURVEY SHEETS.—*Alabama:* Vindiver Quadrangle, 1:62,500. *Alaska:* Fairbanks Special Map, 1:62,500, contour interval 25 ft. *Arizona:* Tombstone Mining Map, 1:6,000, interval 10 ft. *California:* Courtland Quad., 1:62,500, interval 10 ft. *California-Nevada:* Ballarat Quad., 1:250.000, interval 100 ft.; Furnace Creek Quad., 1:250,000, interval 100 ft. *Colorado:* Loveland Quad., 1:62,500, interval 20 ft. *Illinois-Wisconsin:* Waukegan Quad., 1:62,500, interval 10 ft. *Kentucky:* Calhoun Quad., 1:62,500, interval 20 ft.; Georgetown Quad., 1:62,500, interval 20 ft.; Lockport Quad., 1:62,500, interval 20 ft. *Maine:* Lewiston Quad., 1:62,500, interval 20 ft. *Michigan:* Rochester Quad., 1:62,500, interval 20 ft. *Mississippi:* Florence Quad., 1:62,500, interval 20 ft. *Missouri:* Atlanta Quad., 1:62,500, interval 20 ft. *Montana:* Philipsburg Quad., 1:125,000, interval 100 ft. *New York-New Jersey-Pennsylvania:* Port Jervis Quad., 1:62,500, interval 20 ft. *Nevada:* Tonopah Quad., 1:250,000, interval 100 ft.; Kawich Quad., 1:250,000, interval 100 ft. *Nevada-California:* Las Vegas Quad., 1:250,000, interval 100 ft. *North Carolina:* Four Oaks Quad., 1:62,500, interval 10 ft. *Ohio:* Ashland Quad., 1:62,500, interval 20 ft.; Chillicothe Quad., 1:62,500, interval 20 ft.; Miamisburg Quad., 1:62,500, interval 20 ft.; New London Quad., 1:62,500, interval 20 ft.; West Salem Quad., 1:62,500, interval 20 ft.; Wilkesville Quad., 1:62,500, interval 20 ft. *Ohio-Pennsylvania:* Youngstown Quad., 1:62,500, interval 20 ft. *Oklahoma:* Agra Quad., 1:62,500, interval 20 ft. *Oregon-Washington:* Blalock Island Quad., 1:250,000, interval 50 ft. *Pennsylvania:* Sewickley Quad., 1:62,500, interval 20 ft. *Vermont-New Hampshire:* Hanover Quad., 1:62,500, interval 20 ft. *Wyoming:* Laramie Quad., 1:125,000, interval 50 ft. *Yellowstone National Park:* Gallatin Quad., 1:125,000, interval 100 ft. *Yellowstone National Park-Wyoming:* Shoshone Quad., 1:125,000, interval 100 ft.

CANADA.—Minerals. Scale, 1:6,336,000, or 100 statute miles to an inch. Compiled under the direction of James White, Geographer of the Interior Department. Geological Survey, Ottawa, 1908 (?).

Thirty-eight coloured symbols are used to show the distribution of metals and economic minerals. A line extending to the south of Labrador and James Bay and then north-west to the north of the Klondike indicates that the country to the north of it has not been prospected excepting along some of the principal rivers.

CANADA.—Map of the Province of Nova Scotia. Scale: 1:760,320, or 12 statute miles to an inch. With Inset of Cape Breton Island. Scale, 1:1,013,760, or 16 statute miles to an inch. Geological Survey, Ottawa, 1906.

Illustrates the report by E. R. Faribault on the "Gold Fields of Nova Scotia." The gold-bearing series (Lower Cambrian) is shown in slate, granite in red, and the work done or in progress by the Geological Survey is indicated.

BRAZIL.—Carta Geral do Estado de S. Paulo. Scale, 1:1,000,000, or 15.78 statute miles to an inch. Organisada pela Commissão Geographica e Geologica, João Pedro Cardoso, Chefe, São Paulo, 1908.

A fine political map, giving little physical detail, excepting hydrography. Such a map has been rendered possible by the topographic survey of the State, now completed for the eastern part and the surveys of the larger rivers flowing west to the Paraná. An inset gives the plan of the city of São Paulo on a scale of 1:000,000, or 1.5 statute miles to an inch. A table gives the altitudes of the more important elevations; also of the chief towns with their distance by rail from the capital.

BRAZIL.—Topographic Survey Sheet. Ouro Fino, 22°–22° 30′ S.; 3°–3° 30′ W. of Rio de Janeiro. Scale, 1:100,000, or 1.5 statute mile to an inch. Contour interval, 25 meters. Triangulation by H. E. Williams; topography by David McKnight. Geographical and Geological Commission of São Paulo, São Paulo, 1908.

The latest of the excellent topographic sheets issued by the Survey. The colours and style of mapping are exactly those used on our topographic sheets. The fact that the longitude of Rio de Janeiro is used as the prime meridian, of course, somewhat increases the work of generalizing these maps for the atlas sheets of all other countries.

EUROPE.

GERMANY.—Geographisch-Statistische Karten von Deutschland. No. 1, Sprachenkarte. Scale, 1:1,200,000, or 18.93 statute miles to an inch. Von H. Andresen u. H. Bruhn. Verlag von Hellmuth Wollermann, Braunschweig, 1908.

This is the first of a series of wall maps on some of the geographical aspects and conditions of the population in Germany. Twelve colours show the distribution of the population speaking as many languages, and a diagram shows that 92.4 per cent. of the inhabitants speak German. The series is specially adapted for school use. The other maps now published are: (2) Map of Religions; (5) Geographical map; (6) Rain map; (7) Temperature map.

AUSTRALIA.

QUEENSLAND.—Showing Principal Mining Centres and Railways. Scale, about 90 statute miles to an inch. By W. H. Greenfield. Geological Survey, Brisbane, 1908.

Railroads in red and 106 gold, mineral and coal fields designated in figures referring to names of the fields printed on the margin.

QUEENSLAND.—Geological Sketch Map of Queensland, showing Mineral Localities. Scale, 40 statute miles to an inch. Prepared under the supervision of B. Dunstan, Acting Government Geologist, and compiled by H. W. Fox. Third Edition revised to Dec., 1907. Geological Survey, Brisbane, 1908.

Twenty-five symbols in colours show the distribution of geological formations. The principal mineral localities are enclosed in red rings, with abbreviations of the names of minerals and metals which they contain.

QUEENSLAND.—Sketch Map of the Etheridge Gold Field. Scale, 6 statute miles to an inch. By W. H. Greenfield. Geological Survey, Brisbane, 1908.

Figures in red refer to names of mineral and gold mining leases printed on the margin. Railroads, roads and telegraphs.

ATLASES.

ATLAS GÉNÉRAL VIDAL-LABLACHE.—Histoire et Géographie. Nouvelle Édition. 420 maps and insets. Armand Colin, Paris, 1908.

This popular French atlas was first issued in 1894. In the present edition all the sheets are brought up to date, and many of the leading maps are produced on a larger scale. The edition will appear in 26 parts, two of them being issued each month. Part 1 contains France, Géologie; France, Physique, with 3 insets and 2 profiles; France, Agriculture; Cochinchine Française et Cambodge; Indo-Chine Française; Tonkin.

BOOK NOTICES.

Südafrika. Eine Landes-, Volks- und Wirtschaftskunde. Von Prof. Dr. Siegfried Passarge. xii and 355 pp., 47 Illustrations, 34 Maps, Diagrams, Bibliography, and Index. Quelle & Meyer, Leipzig, 1908.

A geographical and cultural summary of South Africa by one of the German masters of geographical science. The book naturally differs much from Dr. Passarge's great work on the Kalahari. He went to South Africa especially to make a thorough study of the Kalahari as a distinctive geographical unit in the southern part of the continent, and his large volume is the authoritative utterance on that region. At the same time, he had an opportunity to observe many parts of the various countries of South Africa and to get a first-hand view of their condition and peoples. These personal observations, together with the material supplied by the works of the leading writers on South Africa (of which he prints a list on pp. 342-3), have been used in the preparation of the present volume. It is intended for a wide circle of readers to whom it is to be commended as a well-arranged and superior delineation of the physical and cultural features of South Africa, a harmonious picture of the land and its inhabitants.

All phases of the description show the clear insight and the discriminating selection of data which mark the geographical expert. The first four chapters relate to the geographical position and discovery of South Africa and its orographical, hydrographical, and climatic conditions. Two chapters are given to its geological formations and their history, two to its flora and fauna, and seven to the highlands, lowlands, steppes, basins, folded mountains, and other physiographical features. After a discussion of the origin of the Kalahari and the problem of climatic changes, eleven chapters (about half the book) are devoted to the cultural features and requirements and the inhabitants—communications, health conditions and minerals, a short sketch of South African history, distribution of races, physical and intellectual conditions of the native, foreign, and mixed races, South African languages, a general review of cultural conditions in the whole of Africa, the indigenous culture of the South African natives of to-day and of the prehistoric inhabitants, and European culture and influence. The Portuguese, German, and British colonies are then described, and the volume ends with a few pages on future development, the author taking the view that the native question is the greatest problem which confronts South Africa.

The work is illuminative from beginning to end and is a very conspicuous addition to our resources for learning what is best worth knowing of the geography, natural wealth, peoples, and prospects, of the southern part of Africa. Its photographs, sketch maps, and profiles are excellent.

L'Etna. By Giuseppe de Lorenzo. 154 pp., 150 Illustrations, and 3 Tables. Istituto Italiano d'Arti Grafiche, Bergamo, 1907. (Price 5.50 lire.)

One of the beautifully illustrated monographs in the "Italia Artistica" series. Each monograph is given to a single city or region. The handsomest of photographic reproductions adorn every page or are spread out into folded panoramas. The letterpress is graphically descriptive and typography and paper help to make an attractive volume. In the present number, Mount Etna is described and pic-

tured from all points of view and from base to top. Sixty-four photographs are given to the mountain alone and we see all its aspects in quietude and eruption, even to the interior of the most important craters. The descriptions are based upon the geology and geography of the region, the story of the volcano in historic times is told, and the setting of the great mountain, from the sea to the hills and plains bordering the inland slopes with their towns and hamlets, people and little farms, is well described in text and picture. The book is meant for the general reader and tourists will find it very helpful.

Canada's Fertile Northland. A Glimpse of the Enormous Resources of Part of the Unexplored Regions of the Dominion. Edited by Captain Ernest J. Chambers. 139 pp., 17 Half-tone Illustrations and 5 Coloured Maps in Case. Published under Direction of R. E. Young, Department of the Interior, Ottawa, 1907.

Contains the evidence heard before a Special Committee of the Dominion Senate during the session of 1906-07 and the report based upon it. In his introduction Captain Chambers says that at the present rate of immigration, Canada's future expansion in agricultural, lumbering, mining and industries will depend upon the exploitation of the vast, unexplored northland. In 1905 Mr. R. E. Young prepared a statement showing that the available lands for free homesteads in the present area of settlement in the western provinces would be exhausted before very long, and calling attention to the possibilities further north and the paucity of information about the country to the north of the Saskatchewan basin.

The result was that a Senate Committee was appointed to inquire and report, from time to time, as to the resources and value of the region north of the Saskatchewan watershed between the Rocky Mountains and Hudson Bay, comprising the northern parts of Alberta and Saskatchewan Provinces and the Mackenzie Territory. The Committee was empowered to send for persons, papers and records, and more than a month in February and March, 1907, was given to taking testimony. The first investigation was practically completed by April and the results are told in this book.

In the evidence heard before the Committee some striking facts stand out prominently, a number of which are summarized in the Introduction. Mr. A. P. Low, for example, said that Ungava possesses a belt of iron-bearing rock, probably 100 miles long and 200 to 300 miles wide, which in the future will furnish a large supply of iron for Canada. He also said that in the region north of Lake Winnipeg is an area of 5,000 to 10,000 square miles of country adapted for agriculture.

Mr. W. F. Breden, a member of the Alberta Legislature, estimated the area of the available agricultural lands in northern Alberta and Mackenzie at 100,000,000 acres. Others testified that at a point some 400 miles due north of Edmonton splendid crops of wheat, barley, oats, peas, etc., have been regularly raised for more than twenty years, the product for 1906 being 25,000 bushels. The production of grain in these sparsely settled regions has resulted in the establishment of local grist mills of considerable capacity which manufacture flour by modern processes. Potatoes and other vegetables have for years been satisfactorily cultivated at Fort Good Hope, on the Mackenzie River, 14 miles from the Arctic Circle. Vegetation matures quickly owing to the long, sunny days of summer. The lakes and rivers teem with fish, there is an abundance of game and considerable mineral wealth, including coal, oil, copper, silver, gold, salt, sulphur, ochre, sand for glass making, etc. Timber also is in important supply.

The Committee say in their report:

Although in the north the thermometer in the winter season registers low temperatures, the cold is much more bearable than are far higher temperatures in countries where there is humidity in the atmosphere. There is said to be little or no difference between the climate at Lesser Slave Lake and that at Edmonton, 250 miles to the south. The Chinook winds blow as far north as Fort Providence and for 21 days during last January it was not necessary to wear overcoats there. West of Peace River Crossing, stockmen must feed their cattle about seven weeks in winter but eastward the snow is deeper and cattle have to be fed a little longer. At Fort St. John on the Peace River they often sow wheat in March and last year began cutting the wheat on the last day of July.

The pioneers in these northern regions are looking forward hopefully to the time when railroads will give them an outlet to markets. Evidence was adduced as to the great extent and possibilities of the inland waterways in the Mackenzie basin. A few steamboats have been plying for years on the longer stretches of the Mackenzie, Peace, Liard and Athabaska rivers, and also on Lake Athabaska and Great Slave Lake. The testimony that by the construction of two stretches of railroad, altogether about 20 miles long, an uninterrupted water and rail route of 3,000 miles may be provided, seems worthy of official investigation.

The Committee presented conclusions for the consideration of the Government to the effect that a railroad connecting existing lines with Fort Churchill on Hudson Bay would open up a large tract of country well fitted for settlement, as well as afford an additional outlet for the products of the West; that to determine the resources of the cultivable land of this district and its forest and mineral wealth, exploring parties qualified to report on the geological formations, soils, timber lands and navigation should be sent out; that although wheat and other cereals ripen as far north as Fort Providence (61° 30′ N.), travel and settlement there have clung to the waterways, so that knowledge is limited to comparatively narrow strips of territory, and the Committee, therefore, cannot report as to the extent of the wheat-bearing belt in the Peace River and Mackenzie River basins. Neither is it clearly established whether the arable quality of the lands throughout the whole extent of these two river basins is uniform, as the evidence covers only a small part of the region.

The photographs show grain fields, timber, prairie,potato fields, a flour mill, a gas well, ox-cart transportation, settlements, etc., and a wide variety of information is recorded on the maps.

Botanische Reisestudien von der Spanischen Mittelmeerküste mit besonderer Berücksichtigung der Litoralsteppe. Von Dr. M. Rikli. viii and 155 pp., 20 Photographic Illustrations, 11 Figures in the Text and Index. Fäsi & Beer, Zürich, 1907. (Price M. 5.20.)

Dr. Rikli is Docent and Curator in the Polytechnic at Zürich. Accompanied and assisted by some of his colleagues and students, he spent the spring months of 1905 and 1906 in the botanical study of the Mediterranean coast of Spain from Catalonia in the northeast to the steppe lands of the southeast. As they wandered through the heaths and steppes, the forests, the *huertas* or garden lands and other cultivated areas and the palm oases of these coast lands, a wonderful variety of wild and cultivated growths was recorded. The finely illustrated book describes the manifold types of vegetation found on the long littoral. The value of the work is largely enhanced by the history it contains of previous explorations of a similar nature, and most of all by the conventional signs prefixed to each botanical name, indicating whether the plant is merely local or extends through the Mediterranean area or is also found in Central Europe or in the East, as in

Arabia, Mesopotamia, and Persia. Due attention is also given to cultural features and the people in these coastal lands.

The Ethno-Geography of the Pomo and Neighbouring Indians. By S. A. Barrett. 332 pp., Glossary, Bibliography, and Maps. University of California Publications in American Archæology and Ethnology, Vol. 6, No. 1. The University Press, Berkeley, Cal., 1908.

The territory occupied by these Indians lies immediately north of San Francisco Bay and extends about 130 miles north and south and 100 miles east and west. Reaching from the coast line to the Sacramento River, it lies chiefly within the Coast Range. Previous to the white settlement this territory was inhabited by Indians speaking seventeen dialects, representing five linguistic stocks: the Pomo, Wuki, Athapascan, Wintun, and Moquelumnan. The Indians live in villages.

The chief purpose of Mr. Barrett's investigation was to establish the boundaries of the Pomo linguistic stock, determine the number of dialects, their relationships and territorial limits and the locations of ancient and modern villages and camp-sites; also, to examine the topography and natural resources as a part of the study of the various phases of aboriginal culture. Much travelling and field work were necessary, as the Pomo now living, and also the Indians of other stocks, are collected in widely separated villages. Vocabularies were taken from as many individuals as possible.

The results of the investigation are prefaced with a description of the geography, climate, flora and fauna of the region, the state of culture of the inhabitants, and the history of exploration and settlement there, the work of the California Missions, the American occupation, and the influence of white settlement upon the Indians. The section on Linguistics deals with language relationships and the dialects and vocabularies of each of the tribes. Two hundred pages are devoted to descriptions of the geographical divisions of the tribes, the modern villages, and old villages and camp-sites. The glossary gives Indian terms from which place names were derived. A large map shows in colours the territory of the Pomo linguistic stock and the adjacent territories of other linguistic stocks with the dialectic subdivisions and village and camp-sites. A smaller black map shows the southern territory of the Wintur stock with villages and camps.

With the settlement of California the habits and mode of life of the Indians were gradually changed. The missionaries gathered them at the missions to instruct them in the new faith, and Indians were gradually persuaded to adopt Spanish dress and manners and to speak the Spanish language. This study of their older life and speech is the seventeenth publication of the University of California in American Archæology and Ethnology.

Die Uganda-Bahn in ihrem Einflusse auf die Eingeborenen. Von Alfred Kaiser. 16 pp. Sonderabdruck aus den "Mitteilungen der Ostschweiz. Geograph.-Commerc. Gesellschaft" in St. Gallen.

About eleven years ago the author, whose specialty is economic geography, had an opportunity to study the Bantu, Nilotic and Negroid tribes and the nomads of the steppes living along the proposed line of the Uganda Railroad. When he revisited British East Africa last year, he was much impressed with the changes observable in the native population. For seven weeks he travelled with a small

escort over the Guasso-Ngishu Highland, where he would not have dared to risk his life on his first visit. The wild Kikuyu warriors were now harmless and several of them were among his carriers in the great steppe region east of the highlands. The once feared Masai were being transformed by British cultural methods, the Wakuafi of the Highlands lived in peaceful kraals around Fort Schimoni, and the Kamasia and Wasegeju returned the tinsel ornaments he gave them, saying their wives would not wear the worthless jewelry and preferred copper coin; and it was almost impossible to collect any objects of native handiwork, more's the pity, for they have abandoned their indigenous manufactures.

He observed, also, that it is now easier to procure native labour; that the black farmer produces more than formerly and sells his surplus, and in this way he is decreasing the danger of great loss of life in famine years, as in 1898, when many perished.

Mr. Kaiser's paper is filled with information. He believes that changes for the better will continue and that Great Britain is to be congratulated as the first of the Powers to prove the good and far-reaching effects upon the native population of a great railroad in tropical Africa.

Meine Beobachtungen in Süd-West-Afrika. Von Dr. Semler. xxiii and 80 pp., 5 Appendices, and 1 Map. Hermann's Erben, Hamburg, 1906. (Price, M. 1.80.)

The writer spent four weeks in the country, presumably in 1906, though his book does not make this point clear. Landing in Lüderitz Bay, in the southern part of the colony, he went inland about 200 miles to Keetmanshoop, from which place he travelled north, partly by automobile through Gibeon to Windhook, the capital, and thence by rail to Swakopmund and Walfish Bay, stopping at several points on the way. On his long land journey he saw most of the regions where Germans are officially stationed or have settled. He interviewed everybody, farmers, merchants, officials, and soldiers, and noted their opinions and needs. He visited the schools, observed the development of the settlements, farms, and industries, and drew some conclusions, though his time for thorough investigation was certainly limited.

In his opinion, the mining and cattle industries will prosper. Though his remarks on the natives are somewhat cursory, he thinks they may be utilized as work people. He outlines the transportation system that, in his opinion, the colony needs and believes that the harbour of Lüderitz Bay may be adapted for shipping without great difficulty or excessive cost. The first 56 pp. are given to a description of the country, as he saw it, and 28 pp. to his conclusions. The appendices are short papers on the economic value of the southern part of the colony by the author, and on railroads, education, geology, etc., by residents of South Africa. The book is a substantial and a thoughtful addition to the literature on German South West Africa.

Beiträge zur Klimatologie und Hydrographie Mittelamerikas. Von Dr. Alfred Merz. 96 pp., Appendix, Map, and Diagrams. C. G. Naumann, Leipzig. (1907.)

A thorough study of the data relating to the climate and hydrography of Central America. It is chiefly based upon the publications of Sapper, Hann, A. B. Davis, Pittier, Mierisch, Moritz Wagner, Harrington and the full records

of the San José Observatory, Costa Rica, and of fifty local stations where climatic data have been collected for more or less extended periods. In his introduction, Dr. Merz, who is instructor in Hydrography and in the Geography of Europe in the University of Vienna, discusses the observational records and map material available for his purpose and describes the physico-geographical conditions of the San Juan River basin. Dividing his subject into three sections, he treats (1) of the precipitation and evaporation of Central America (including the annual means of cloudiness and relative humidity); (2) the flow off and its distribution; and (3) the relations between precipitation, flow off, and evaporation, including the influence on vegetation. The three sections are illustrated by 31 tables of observations, each of which is discussed and generalized. In the appendix, the author assembles in 9 tables the most important features of the observational material which he has utilized. The paper is supplemented by 12 figures giving graphic expression to the deductions drawn from the tables and a map in colours showing the precipitation in the basin of San Juan River for the years 1898-1900. The paper will be welcomed as a systematic study of our existing knowledge of the climatic conditions and hydrography of Central America.

Lecture des Cartes Anglaises et des États-Unis. Indications linguistiques, géographiques et topographiques. Par Capitaine P. Pollacchi. 159 pp., avec signes conventionnels, Librairie Militaire R. Chapelot et Cie., Paris, 1908.

The earlier work by Captain Pollacchi on the "Lecture des Cartes Russes" was reviewed in the BULLETIN (April, 1908, p. 254). He has now performed the same service in a large part of the fields of official map-making in the United Kingdom and the United States, and, so far as he covers the ground, his volume contains much information that will be useful to map students, not only in foreign lands but also in the two countries named.

In the British section he mentions the Admiralty charts and the maps of the Post Office and Railway Clearing House, but nearly all the descriptive matter is given to the products of the Ordnance Survey. In our country, the U. S. Geological Survey has practically a monopoly of all he has to say in his "Notions générales sur les Services Géographiques" about our official mapping. No mention is made there of the map and chart productions of the Coast and Geodetic Survey, the Hydrographic Office, the Land Office, the Post Office and the Department of Agriculture, all of which make distinct and some of them voluminous contributions to our map publications. He gives later, however, a full list of the conventional signs used by the Coast and Geodetic Survey and the Hydrographic Office. Perhaps most of our own people know little as yet of the activity, in map production, of the Department of Agriculture, but it is rapidly producing maps of its soil surveys in many parts of the country. If a second edition of the work is prepared, it is to be hoped that these omissions will be remedied. The author has very systematically arranged the facts concerning the organization and the products of the Geological Survey. The larger part of the work is given to a list of names and terms used on maps in the English language, but derived from many languages, with their meaning in French; also, explanations of the symbolism and abbreviations employed in British and U. S. marine charts, and geodetic survey sheets, the French transcription of Chinese names written in English, the scales of English and American maps and their equivalents in metric scales and measures, weights and money and their metrical equivalents.

The Geology of North Central Wisconsin. By Samuel Weidman. xxxi and 697 pp., 80 maps, diagrams, and half-tone Illustrations and Index. Wisconsin Geological and Natural History Survey, Madison, 1907.

The author is the geologist of the State Survey. His report is of value not only to geologists and to the commercial and economic interests of the State, but also to the general reader and the high school and university student. Dr. Weidman says in his preface that one of the principal objects of the Survey reports is the educational value to the citizens and schools of the State. This purpose is admirably fulfilled in the present volume, and it is a good example of the present tendency to write such reports in a way to enlighten and educate the reader and to supply material for the use of competent teachers in the class room.

The report describes the principal geological features of a large area in North Central Wisconsin where the problems are mainly those relating to the earliest rocks, the Pre-Cambrian, and to the very latest rocks, the Pleistocene or glacial. There is a great gap between these widely separated formations and it is represented by the records of a vast amount of erosion extending through a very long period of geological time. Summing up the investigation, Dr. Weidman says that the Pre-Cambrian formations consist, to a relatively small extent, of metamorphosed sedimentaries and to a very large extent of igneous intrusives. The problems of the igneous rocks are sketched only in outline, and there are questions concerning them and their mineral contents that require further study, but some new minerals have been discovered and some new associations of minerals are described.

The glacial deposits of this area supply the records of four different ice invasions. A distinct and fascinating part of the report is the account of the development of the topographic features, the plains, hills and valleys that diversify the area, and the agencies by which these surface reliefs have been moulded into their present condition. This physiographical chapter is a treatment of the geography of North Central Wisconsin from the viewpoint of its origin, and it should be of great usefulness to teachers of physical geography in the schools.

The volume should be of special interest to all intelligent citizens living in the part of the State which it describes. The text and maps enable them to find the exact locations of the geological formations and the topographical features described. They will learn much by studying their immediate surrounding with this report as a guide.

Researches in Assyrian and Babylonian Geography. Part 1. By Olaf A. Toffteen. 59 pp., 2 Maps, Geographical List to R. F. Harper's Assyrian and Babylonian Letters (Vols. I–III.) and List of Abbreviations and Books Quoted. The University of Chicago Press, Chicago, 1908. (Price, $1 net.)

These researches include the lands of Isua, Daria, and Bît-za-Mâni. The author, who is Professor of Semitic Languages and Old Testament Literature, in the Western Theological Seminary, Chicago, gives the names of various regions and places mentioned in Assyrian and Babylonian letters and inscriptions. He collates the various allusions to the same place, and from these references, one or more in number he draws his conclusions as to the approximate or exact geographical location of the place or region named. In many cases the evidence is slight, and Dr. Toffteen makes only tentative geographical deductions, or none at all. The following quotation, relating to the City of Damdamusa, will give a clear idea of the method used:

In the revolt of Ilâni, governor of Zamâni, Asurnasirpal III, reached the city of Damdamusa from Parzanistun and from Damdamusa he went to Amedi. Damdamusa was, consequently, situated

north of Amedi. It may also be inferred that it lay near by or on the Tigris on its western bank, because this is the first city of Zamâni that Hulai, who evidently marched through Subria, reached and captured. In Damdamusa, Asurnasirpal built granaries for storing the grain of Subria, and this would imply that the city would be near the Tigris, over which the people of Subria had to transport their tax-corn. Had it been inland, the Subrians would have found it more convenient to ship their grain to Tusha, which lay south of them on the southern bank of the Tigris.

A Biological Investigation of the Athabaska-Mackenzie Region, North-American Fauna, No. 27, by E. A. Preble, U. S. Department of Agriculture, Bureau of Biological Survey, Washington, D. C., 1908. pp. 1+575; figs. 16; plates 25.

A very notable piece of exploratory work has been embodied in this excellent report on the geography and biology of that immense section of the continent known as the Athabaska-Mackenzie region. The region does not offer such varied problems for research as are to be found in regions of greater relief, but gains in interest by reason of its transitional qualities due to its position well toward the margin of the habitable lands. Within its borders live the last wild herds of that all but extinct species, the American bison; while the musk-ox, equally interesting, lives on the Barren Grounds where, unless protective measures are invoked, it is doomed to extinction in the near future. Representatives, and in some cases the bulk of the individuals, of most of the migratory game birds breed within its borders in millions. These, wintering in the United States, are of great economic importance. The report before us gives a detailed account of the various species of plants and animals, their adaptations and variations, their geographic distribution and their economic relations. Such reports are available in more or less complete form for other sections of the continent, including Labrador, Hudson Bay, Alaska, etc., but the Mackenzie region remained the most neglected large area in North America.

An important part of the report relates to climate and physiography. Temperature summaries are expressed in tabular fashion; likewise the dates of seasonal events at various stations. Such events include the first thaw, and the appearance of the first migratory birds from the south in the spring, and that of the migratory northern animals like the Barren Ground caribou from the north in the autumn. Some instructive climatic generalizations appear concerning topics of wide interest. The Peace River valley, of importance on account of its wheat-growing possibilities, exhibits the peculiarity of having an upper trans-mountain section protected from the northerly and easterly cold winds, with a mild winter climate; and a low plains section with almost Arctic conditions in winter. The middle section, just east of the Rockies, suffers violent extremes of temperature from the dominance now of one, now of the other set of conditions. The soil of this middle section is favorable, and combines, with the powerful though irregular chinook winds, to make the section one of considerable agricultural promise.

The geographer finds much gratification in the precision here given to such rather vague generalizations as to the extent of the Barren Grounds and the location of the tree-line. The Barren Grounds have been well described in earlier reports, but not well mapped. Their greater part is every season covered with short grasses, mosses and small flowering plants. On the peaty and sedgy portions and along the smaller rivers and lake banks grow Labrador tea, crow-berries, dwarf-birch, willows, etc. Some spots are practically sterile, others are abloom in spring with masses of bright flowers. From the mouth of Churchill River, Hudson Bay, the northern boundary of the great transcontinental spruce forest follows the shore closely for a few miles, then curves gently inland. Thence it extends northwesterly, crossing Island Lake, Ennadai Lake on Kazan River, and Boyd Lake on the Dubawnt. The next dividing point

is just north of 60° on Artillery Lake. From this point the line curves southwesterly crossing Lake Mackay south of latitude 64°. The banks of the Coppermine are the boundary to 67°. Tongues of timber follow the northward flowing streams, with their warmer water, well into the Barren Grounds. The most remarkable case of this kind is that of the Ark-i-linik, a stream tributary to Hudson Bay. From a point near latituds 62½° north, within the main area of the Barren Grounds, a more or less continuous belt of spruce borders the river to latitude 64½°, a distance of over 200 miles by river. A few species of woodland-breeding birds follow these extensions of the forest to their limits. Alders occur in more or less dwarfed conditions in favorable places well within the treeless areas, and several species of willows, some of which here attain a height of 5 or 6 feet, border some of the streams as far north as Wollaston Land. These are the only trees which occur even in a dwarfed state in the Barren Grounds proper. The principal trees of the spruce forest whose northern limit is thus defined are the white and black spruce, whose range is coextensive with the forest limits, the canoe birch, tamarack, aspen, and balsam poplars, Banksian pine and balsam fir common in the southern part of the belt and terminating from south to north about in the order given. With these are associated, generally in the form of undergrowth, a variety of shrubs. The tree limit on the western mountains in latitude 56° is at about 4,000 feet. The head of the Mackenzie delta is marked by islands well wooded with spruce and balsam poplar. Lower down these trees give way to willows which continue to the sea.

The life zones included in the region comprise parts of three subdivisions—the Arctic, Hudsonian, and Canadian Zones. The boundaries of these zones are shown in a very useful map in considerable detail. Each zone is summarily described in a clear and comprehensive manner.

A feature of the report that greatly enhances its usefulness is the chapter on previous explorations, which for this region is as useful for the student of exploratory history as Brooks' chapter of a similar sort for Alaska in the Geography and Geology of Alaska (U. S. G. S., Prof. Paper No. 45). The report is illustrated with very clear photographs, showing a large variety of geographical conditions along the banks of the streams explored and within the spruce forest. The largest part of the work is of course, taken up with the detailed description of the occurrence, range, habitat, and conditions of life of the animal and plant species observed by the author or noted in the journals of earlier explorers. I. B.

Im Morgenlicht. Kriegs-Jagd-und Reise-Erlebnisse in Ostafrika, von Hans Paasche Oberleutnant zur See. Mit 97 photographischen Aufnahmen des Verfassers. Berlin, Verlag von C. A. Schwetschke und Sohn. 1907.

Travellers are legion who in this day hear the call of Africa. The "morning-light," in some sections approaching noonday brightness, will soon make the expression Darkest Africa as much out of date as is the expression Dark Ages, once employed by the historians to characterize a period about which they knew little.

Lieutenant Paasche is a good traveller. He sees things and can tell of what he sees in an interesting manner. Such a book as this has the personal element always in the foreground.

That is told which particularly interests the traveller himself, but occasionally this appears trivial to the reader. This volume will hardly pass down as a great work; it is a book of the time, but will serve for instruction in some things and places African. The illustrations, well done, tell, in themselves, an entertaining story.

E. L. S.

Anecdota Cartographica Septentrionalia. Ediderunt Axel Anthon Björnbo & Carl S. Petersen. Hauniæ Sumptibus Societatis Regiae Scientiarum Danicæ, MCMVIII. Letter-press with eleven collotype facsimiles.

In this work we have a valuable study of the cartography of north European lands, critically and neatly presented. The author refers to his work as a collection of cartographical sources relating to the north, chronologically arranged, from the fourteenth to the seventeenth century. It includes all as yet unpublished maps of the north that possess certain and independent value as sources, and excludes all others, however interesting and decorative they may be. Especially to be commended is the sense of responsibility which the authors have felt, and have expressed, respecting the reproductions. They have endeavoured to be true to the originals, and they express condemnation of devices often employed for "making up maps," of "artificial means by which maps in reproduction are made more legible, but at the expense of reliability." They admit, however, a violation of their principle in reducing the size of the maps, and in adding a bit of colour to a few of them that the distinction between water and land may be the more pronounced. An important part of the work in editing old maps should consist of readings and interpretations of place names. In this part of the work the authors have done well, adding, in three instances, names taken from other maps partly for the purpose of showing origins. The study is not extended beyond 1700, because from that date material increases greatly in extent, and the maps change in character; exact map-drawing is increasingly prominent. Within the three hundred years these maps are very diversified, different types succeed each other, good maps and bad maps are combined together without critical judgment, but it was within this period that the north came to be well known. Only that section of each map is reproduced which has to do with the north lands.

The eleven reproductions include maps of Martellus, Pilestrina, Anthoniszoon, Jorden, Simon von Salinghen, and a few given as anonymous. In the tables, which appear to have been carefully made, only names found in the northlands are given.

E. L. S.

The Quarterly Journal of the Royal Meteorological Society, April, 1907, contains the presidential address of Mr. Richard Bentley on "Weather in Wartime," delivered before the Royal Meteorological Society, January 16, 1907. Thus far but little attention has been paid to the large and important question of the relation of climate and weather to military operations. The field is an interesting one, and is worthy of cultivation. In "Outlines of Military Geography," by T. M. Maguire (Cambridge, Eng., 1899), there is a chapter on the "Influence of Climate on Military Operations," but beyond that there is little systematic discussion of the subject. In his address Mr. Bentley views a large number of campaigns, sieges and battles, and dwells upon the influence of wind upon weapons and vessels in the early days of war. Many invasions in the days of small craft were frustrated by stormy weather, from the time of Xerxes to the days of the various Spanish armadas which sailed in succession to the shores of Great Britain. Now, with large vessels, good charts and instruments, storm warnings, and, above all, steam, this disability has passed away, and wind has ceased to be of as much importance as formerly, unless, indeed, hostile operations are transferred to the air itself, when the weather will once more be of supreme importance. Restrictions by seasons are illustrated in the attack on the Boca Chica; on

Buenos Ayres; in the siege of Louisburg; the terrible retreat from Russia, and in the operations on the Gold Coast. Fog has constantly been present during the operations of war, most frequently, perhaps, on land, though the sailors had their share at Barfleur, Cape St. Vincent and before Tsushima. Indeed, on one memorable occasion, the *Centurion*, with Lord Anson on board, sailed through the French fleet undetected. Three great men lost their lives through fog, Sir Philip Sidney at Zutphen, Gustavus Adolphus at Lützen, and the Scot, Marshal Keith, in the Seven-Years' War. The result of the battle of Barnet was due to fog, and Frederick the Great was misled by it at the battle of Lowositz. The part played by rain, too, is an important one in history, from the loss of Varus's legions in Westphalia down to the destruction of the Duke of Tarentum's army in Silesia. The siege of Vienna by Solyman failed through rain. Napoleon was defeated at Caldiero from the same cause, and the operations of General Lee in 1863 during the Civil War were hampered by it. Reference is also made to the passages of the Alps in snow from Hannibal's time to that of Napoleon; to the march of the Sikhs to relieve Chitral, and to the snowstorms at the battles of Hohenlinden and Eylau, and during the French retreat from Russia. Ice has been favourable to military operations. It was employed for the defence of the Balkans, and in 1800 in the Tonale Pass on the Italian frontier the Austrians made use of it in cubes to build forts, which turned out to be impregnable. Charles the Tenth crossed from Sweden on the frozen Baltic to invade Denmark, and General Pichegru overran Holland in 1795 when its rivers and canals were frozen, and even captured some vessels by sending his cavalry to sea, when their horses feet were made rough, over the ice. Illustrations of campaigning under great heat are given from the time of the great Captain Gonsalvo de Cordova to that of Sir Charles Napier in Sind, and Lord Strathnairn in India, and to the recent battle of Yosherei in 1904. The destruction of Cambyses in a simoom (?) and of the Emperor Julian in his Persian campaign are alluded to. Several engagements have taken place in the height of gales, such as Admiral Hake's victory at Quiberon and Admiral Rodney's off the Spanish coast. Other interventions of weather are noticed, such as the mirages which haunted the exhausted French troops in the desert, and the temporary lowering of the waters of the Baltic and of the Sea of Azof in special winds, which permitted the fortress of Stralsund and the celebrated lines of Perekop to be captured. R. DEC. W.

The Building of an Island, being a Sketch of the Geological Structure of the Danish West Indian Island of St. Croix, or Santa Cruz. By John T. Quin, F.R.G.S. The Author, Christiansted, St. Croix. 1907. 4to.

The twelfth or concluding chapter of the work under consideration begins as follows:

> While it seems desirable, in entering on the study of the geological formations of our island, to begin with the younger set of rocks and trace the story backwards, it may be instructive, in summarizing the results of our observations, to take the opposite course, and, as far as possible, note leading events and conditions in their natural sequence.
>
> As a preliminary, we must remember that the crystalline structure prevalent in our older formation has been induced in the strata since the materials of which they are composed were deposited, and similarly that the dikes of igneous rock which we find cutting them through have been intruded so that in the first instance we have to confine our thoughts simply to their deposition.

While thanking the author for the valuable suggestion that the components of a rock were on hand when and where that rock was formed, we, and prob-

ably a great many others, had been bold enough to suppose this fact without first consulting him. He is manifestly a schoolmaster, or, as modern American terminology has it, an "educator," and he attempts in twelve dismal chapters and with the aid of diagrams and plans, together with a map as recent as 1856, to "educate" us to a vague conception of the building or formation of the island of St. Croix in the Danish West Indies. The above quotation gives an idea of his average style, but we shall not attempt to give specimens of the pedantry displayed in almost every part of the book. It is difficult to conceive whether that book is written for a well-informed public or for a primary school. If for the former, the childish object lessons, as in the first chapter, the tiresome and almost offensive explanation of the cause why lime-rock effervesces in muriatic acid and clay does not, the interesting statement that soils are classed among rocks, and the almost endless dissertation on Foraminiferæ and the like are wholly superfluous; if for children, the bulk of the text has too many pretensions to being technical.

We look in vain for terse, logical conclusions. All we can discern is, that the author favours the opinion that there may have been two successive formations of the island, one, possibly anterior of the Cretaceous period and followed by submersion; then again, slow upheavals and subsequent deposits so as to form another dry surface. The latter "perhaps" at the time of the chalk formation. Trap dikes indicate that the volcanic forces have, to a limited extent, risen to the degree of eruption on the surface. We do not attempt to penetrate any further into the intricacies of the book, wishing the reader much patience in his endeavours to peruse it. The illustrations are mostly quite commendable. A. F. B.

British Rainfall, 1907. By Hugh Robert Mill. 8vo. London, Stanford, 1908. Pp. 280.

The 47th volume of *British Rainfall*—surely a good, long record of important scientific work, faithfully done. Dr. Mill, in his report, notes that the late Mr. G. J. Symons began his systematic observations of rainfall at 9 A. M., Jan. 2, 1858, so that the fiftieth year of the Camden Square rainfall station was completed Jan. 1, 1908, a half-century of unbroken observations. When we read of the many activities of Dr. Mill, the present director of the British Rainfall Organization, we can but wonder at his being able to carry on this rainfall work so successfully, year by year. The present volume contains the records of over 4,000 observers. There are special discussions of important rainfall features of the year; of the thunderstorms of July 21 and 22, with half-tone views of damage caused by them; extracts from Dr. Mill's address before the Royal Meteorological Society on "Mapping Rainfall," and the usual observers' notes, and tabulations.

R. DEC. W.

INDEX TO VOL. XL.

MAPS AND ILLUSTRATIONS.

MAPS, DIAGRAMS AND PROFILES.

ILLUSTRATIONS.